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Conducted by MAJOR B. BADEN-POWELL, F.R.A.S., F.R.Met.Soc., and E. S. GREW, M.A.

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The Recent Total Solar Eclipse, January 3, 1908.

WILLIAM J. S. LOCKYER, M.A., Ph.D., F.R.A.S.

IN the February number of this Journal I described the contents of the cable which I had received from Mr. F. K. McClean, in which he stated that the eclipse had been successfully observed and photographed, but that the first minute of totality was cloudy. Since that time much additional information has been received, which describes not only the eclipse itself, but the preparations for the event and interesting notes about the island itself.

Mr. McClean left Auckland on December 12 in the s.s. *Taviuni* (see fig. 1), which he chartered to convey himself and party to Flint Island and back. Neither land nor ship was sighted by them till the 18th, when they passed Manzaia, which lies south-east of Raratonga. On the 20th Tahiti was reached, its mountain tops being enveloped in clouds and rain falling heavily. Papeeti, the principal town, is described as consisting of numerous white houses situated amongst a great number of trees, with two church spires forming a conspicuous feature. The background was made up of a belt of palm trees and bright green mountain sides.

This port was left in the evening of the 21st, and on the morning of the 23rd a long, flat island, fringed with surf from end to end, was sighted. This was Flint Island,

[*Photo Gregory, Auckland.*

Fig. 1.—S.S. "Taviuni," which carried the Eclipse party to Flint Island and back, from Auckland.

[*Photo Winkelmann*

Fig. 2.—Surf boat making for the opening in the reef. S.S. "Taviuni" in the distance.

the destination of the expedition, and their home until the eclipse of January 3 was over.

Rain seemed to be quite the normal state of things at that time of the year for that part of the world, and heavy rain was falling as the *Taviuni* stopped off the channel at 6·30 a.m.

Flint Island, it will be remembered, is a small coral island, and the entrance channel is where the reef has been blown up in order to make landing possible.

Very little delay was made in getting the numerous packing cases ashore, and this was done by means of surf boats, one belonging to the ship and the other to the island, in spite of the heavy rain that was still falling. Some idea of the landing difficulties will be gathered from the accompanying illustration (fig. 2), which is from one of Mr. Winkelmann's numerous excellent photo-

graphs. The boat here illustrated had on this occasion half of her side torn out owing to being thrown against the coral by the large breakers.

The island itself is all broken coral and palm trees, and when it came to erecting the tents and instruments a great amount of lopping had to be done. The tents were

A B

[Photo Winkelmann

Fig. 3.—The supporters of the giant turtle. A.—Professor Campbell. B.—Mr. McClean.

put up near those of the American party from the Lick Observatory, who, under the direction of Professor Campbell, had already taken up their quarters on the island. Rain was the order of the day both on the 23rd and 24th, but considerable progress was made in setting up the instruments. As both parties found that it was as

B A

[Photo H. Winkelmann.

Fig. 4.—Rating the clock of the Siderostat. A.—Mr. F. K. McClean. B.—Mr. J. Brooks.

wet on land as in the sea they worked chiefly in bathing or native costumes.

The united parties, judging from the *menu* sent home, had a most sumptuous repast on Christmas Day, turtle forming a prominent part of the dinner. Turtle, it may be remarked, abounded in great quantities on the island, and the accompanying illustration (fig. 3) serves to show their size, and incidentally the normal costume of the observers. The fact that the chiefs of the two expe-

[Photo F. K. McClean

Fig. 5.—The site of the siderostat, appropriately lettered.

ditions are acting as supporters to the turtle indicates the importance they attributed to it.

Twice each day the *Taviuni* steamed close in to make inquiries, otherwise she waited about outside.

[Photo H. Winkelmann.

Fig. 6.—Mr. McClean's camp on Flint Island.

By January 1 all the instruments were in their final positions and drills were commenced, the signals being taken from the American timekeeper. The arrangement

of the instruments was as follows: The sun's light was thrown horizontally in a southerly direction by means of a large siderostat carrying a 22-inch mirror, and the various instruments were so placed that they received this light on their object glasses, either directly or by the intermediary of small secondary mirrors placed in the main beam. Messrs. McClean, Brooks, and Walker operated a 5-inch De la Rue coronagraph and a small grating spectroscope, the former being fed directly by the siderostat. Messrs. Short and Caffyn worked a coronagraph of seven feet focal length and a tele-photo camera, the former being parallel and alongside the De la Rue. Mr. Winkelmann also used a tele-photo camera, taking the light also by reflection from the main beam. Mr.

[Photo H. Winkelmann.

Fig. 7.—The American instruments on Flint Island, showing the 40-foot coronograph and the smaller instruments.

Raymond drew a sketch of the corona, using a small telescope equatorially mounted. Fig. 4 shows the mirror of the siderostat just protruding from the tent and portions of the two larger instruments. The luxurious growth of the palms will be noticed in the back-ground.

Eclipse day opened fine and remained so with very slight breaks till 11.10 a.m. The partial phase commenced at 9.45 a.m. and totality was due at 11.17 a.m. At 11.15 a.m. rain began to fall, and the instruments had to be hurriedly covered up. A slight break in the cloud and then another cloud prevented the first minute of totality from being utilized. After that the cloud thinned out and cleared away, and the remaining interval of totality was successfully taken advantage of. The eclipse was over. To strike camp was then the order of the day. During the morning men from the *Taviuni* had pulled down the tents and placed them and most of the personal kit of the observers on board. At 11.30 a.m. the instruments were begun to be dismantled, and, with a brief interval for lunch, the last packing-case reached the shore at 2.45 p.m., and the ship left at 3.50 p.m. the same afternoon. Veritably a record packing up!

Due precaution, however, was taken to protect the undeveloped exposed plates. These in their holders were wrapped up in waterproof canvas and straw and again in more canvas, then they were put into barrels which also were made watertight.

The original negatives and their copies have all arrived safely in London, and it needs only a cursory glance at them to show what a great success has been achieved.

Some time will elapse before the results of the discussion of the photographs will be published, but it may be stated that the corona appeared like an irregular star with seven long streamers, some of which must have visually extended two or three or more lunar diameters, judging by their lengths on the negatives. They occur in high as well as in low solar latitudes, and while some are pyramid shaped near their base, others shoot straight out from the lower corona.

Before leaving the site of the camp the concrete base was appropriately lettered as indicated in an accompanying illustration (fig. 5). The photograph also shows all the members of Mr. McClean's party who made observations. These, reading from left to right, were as follows: Mr. Flynn, first officer, *Taviuni*; Mr. Caffyn, purser, *Taviuni*; Mr. H. Winkelmann, Auckland; Mr. F. K. McClean; Mr. W. E. Raymond, Sydney Observatory; Rev. F. W. Walker, Auckland; Mr. J. Short, Red Hill Observatory, Sydney; Mr. J. Brooks, Sydney. Thus an enterprising and well-planned expedition was brought to a successful conclusion. and great credit is due to Mr. McClean for enriching British Astronomical Science with the records of the South Pacific Eclipse.

In one respect it is sad to think that even though we have Institutions which study the sun daily, such an event as this eclipse should have been left to private and individual effort. On the other hand, it is very pleasing to know that there are men who will put themselves to a great deal of expense and trouble to obtain records which otherwise might never have been secured at all.

THE first four parts of Richard and Cherry Kearton's "British Birds' Nests," have been received from the publishers, Messrs. Cassell and Co. The serial work, which is to be completed in 16 fortnightly numbers of 1s. each, will form a second and revised edition of this popular book. One finds in the parts under notice quite a number of beautiful full-page pictures, characteristic of the work of Cherry Kearton. Most of the illustrations are printed on plate paper, but Rembrandt plates form the frontispieces to Parts I. and III., whilst in the second and fourth parts we have in each two plates of birds' eggs produced in colours. In alphabetical order is given an illustrated description of how, where, and when to find the nests of the birds which visit this island; details of the materials used in building the nests, and interesting notes of the birds which breed in them.

XUM

Honey Hiding Places.

By G. CLARKE NUTTALL, B.Sc.

THE flowers have wonderful hiding places for their honey. Not every flower, it is true, counts honey among its assets, not even all the showy ones such as the poppy and the rock rose, who seem to make the greatest efforts to attract insect visitors, still those flowers—and they are many—that do produce it have

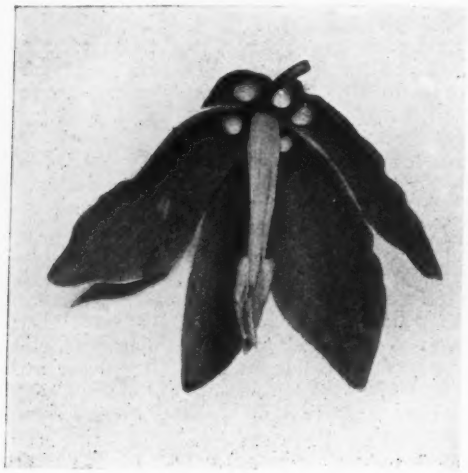

Fig. 1.—The Crown Imperial Lily (*Fritillaria imperialis*) cut open to show five of the six honey pits, each filled with a large drop of honey.

evolved all sorts of devices for hiding it away. But these honey hiding places—like the priest's hiding holes in ancient mansions—are meant to be found by the right sort of visitors, and are only hidden away from rude intruders, and when they do occur they are part of that plan of structure and mechanism which Nature, the great architect, has laid down in each individual

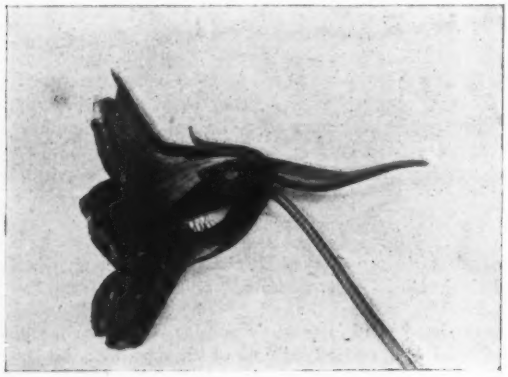

Fig. 2.—In the Nasturtium (*Tropæolum*) the honey is hidden at the far end of a long spur leading off one of the sepals.

flower, and are so arranged that an insect visitor in search of honey must needs pass along a certain path if he would arrive at it. It is his passage along this path and the ensuing consequence of his becoming a pollen carrier—and hence a cross-fertiliser—that the plant desires.

Let us explore, then, some of these places where honey hides and where, as Ariel says, "the bee sucks," and see something of the wonderful ingenuity that is displayed. We shall find that in the large majority of cases the honey is tucked away in the flower itself, though there are striking exceptions, but even within the narrow limits of a flower there is the greatest possi-

Fig. 3.—The five honey sacs in a Buttercup (*Ranunculus*) are placed at the point of insertion of the petals.

ble diversity in its position and its form, and we shall perceive that there is no part of a flower which is not made in one plant or another the carrier of a honey bag.

One of the most striking shows of honey that we know in this country is that which we discover when we peer into the recesses of the Crown Imperial lily (*Fritillaria imperialis*). There, at the centre of the

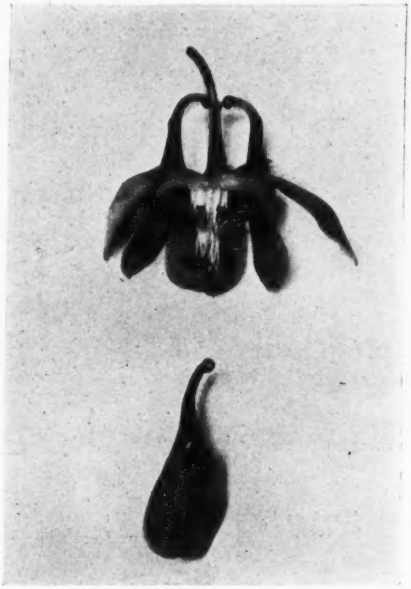

Fig. 4.—In the Columbine (*Aquilegia*) the honey is stored in a knob at the top of each horn-like petal. There are five petals and five nectaries.

brilliant-hued perianth, can be seen six large honey pits, one on every floral leaf, and each is brimming over with a big drop of honey and glistening like a tear drop. Shake the flower and it "weeps" as the big drops fall from it, soon to be replaced by yet other "tears" in the quickly secreting flower. "Job's Tears" the country folks sometimes call these lachrymose plants.

In the Martagon lily (*Lilium martagon*) the honey is confined in swollen veins or channels which traverse the perianth leaves—rivers running with sweetness. The snowdrop (*Galanthus nivalis*), little as it is suspected of honey-like tendencies, nevertheless has also veins of nectar coursing through its fragile whiteness.

Honey is very rarely produced in the sepals of a flower, but the nasturtium (*Tropæolum*) is one of the exceptions. To be sure the nasturtium sepals are a little eccentric anyway, for instead of being small, green, and insignificant as is the general rule, they are brilliantly coloured and rival the petals in glory. Then one of them takes upon itself the function of honey-providing, and for this purpose it is produced backwards into a very long-pointed spur which is quite hollow, but which, if bitten, gives a taste of sweetness mingling with the usual acridness of the flower, the sweetness chiefly lying at the remote tip.

It is the petals of a flower that most frequently are the honey carriers, but even they have no uniform plan for performing this office. The buttercup (*Ranunculus*), for instance, places a honey sac at the point of insertion of each of its golden petals so that there are five honey

(*a*) (*b*) (*c*)

Fig. 5.—The flower of the Dead Nettle (*Lamium Album*). (*a*) The complete flower; (*b*) the "Suckie," pulled from the petals; (*c*) a section of the flower illustrating the hollowness of the corolla tube.

sacs lying in a ring beneath the multitude of stamens. The columbine's (*Aquilegia*) petals are marvellous contrivances, their form being elaborately designed with a view to being good honey hiding places. Each is circular, hollow, and shaped like a horn, as the picture shows. In each the honey is secreted in a round knob at what would be the mouthpiece end of the horn, and the five are arranged in a ring side by side with the honey knobs aloft. Though the honey store is obvious from without, yet the insects who would sip it must creep into the flower and penetrate with a long proboscis up the curving horn to the knob.

Sometimes the petals are all joined together into a tube and the sweet nectar simply exudes from the inner side of the wall and collects at the bottom. This is the case in the dead nettle (*Lamium*), the corolla tube of which, pinched from the stem, forms so toothsome a morsel that the children call it "suckies." The honeysuckle (*Lonicera*) is similarly planned, and its sweetness is so striking a feature as to have given it its name.

At other times the petals change completely into honey bags, pure and simple. This happens in the Christmas rose (*Helleborus*), for instance, where the petals are represented by a ring of small greenish tubes standing erect (the sepals are the white and attractive feature of this flower), which tubes are merely storehouses for the flower's nectar and a very obvious part of the flower, as the photograph shows. In the monkshood (*Aconitum*), which belongs to the same family as the Christmas rose, the nectaries are extremely quaint. If

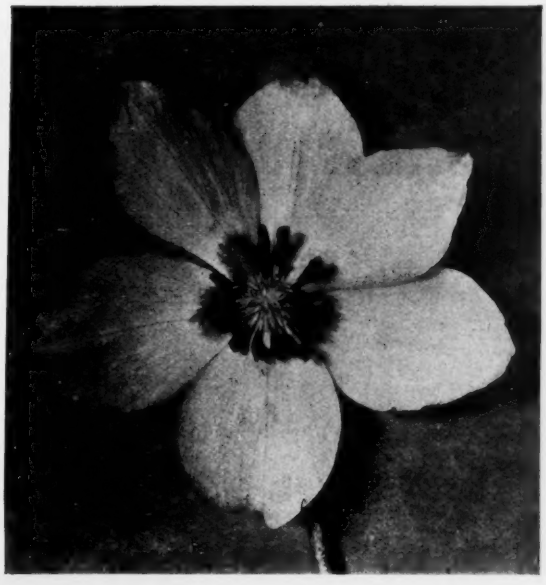

Fig. 6.—The Christmas Rose (*Helleborus*) showing the dark ring of honey filled tubes—the transformed petals. The sepals have become white and petal-like.

the hood which gives its name to the plant be drawn back there suddenly spring into sight two objects on long stalks which are sometimes like a French horn, sometimes like a cowl, or, looked at sideways, not unlike a pair of doves. Their presence within the hood—just as two people might be in a room—has given the

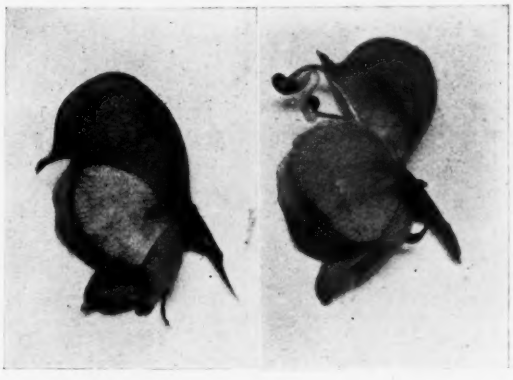

Fig. 7.—The Monkshood (*Aconitum*) has two peculiar nectaries on long stalks, carefully hidden away inside its hood.

plant the curious name of "Adam and Eve" and "Noah's Ark." Thus are the honey bags carefully tucked away and protected by the monkshood. Indeed, so little hint does the flower give of their presence from outside that unless a person has actually dissected a flower for himself he is absolutely ignorant of them,

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though they are most striking in appearance when their hiding place is once discovered.

There seems no end to the ways in which petals can secrete honey. In a few plants, as in the mullein (*Verbascum*), the nectar simply exudes from their upper surfaces and lies sparkling like dew upon them; in

Fig. 8.—A Globe Flower (*Trollius*) with a petal removed to show the ring of spoon-shaped honey glands.

other cases, as in the wild valerian, there is a minute pocket at the side of the petal tube which contains it, and so on. In fact, the petals are that part of the flower which plays much the largest *rôle* in honey producing.

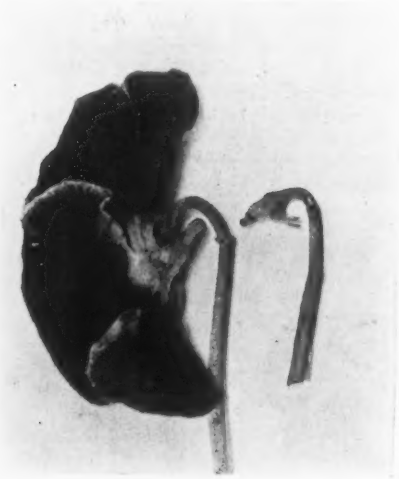


Fig. 9.—A section through a Pansy (*Viola*, showing the reservoir pouch in the petals. In the smaller object the petals are removed to show the long humps on the stamens with the honey glands at their ends.

In the globe flower (*Trollius*) there are very curious spoon-shaped honey glands which stand in a ring just outside the many stamens. A petal has been cut away from the globe flower photographed so that these glands can be seen in the interior.

The marsh plant "Grass of Parnassus" (*Parnassia palustris*) boasts of even more singular structures which are, at the same time, very beautiful and lend an air of uniqueness and delicacy to this attractive flower. On the inner side of each petal is a lyre-shaped object composed of the finest green filaments each tipped with a tiny knob. These filaments arise from a piece of flattened green tissue. Though at first sight one would naturally imagine that the tiny knobs were the honey glands, yet investigation shows that they are hard and dry, and contain not one particle of nectar, while the disc of tissue is really the honey sac. So it follows that the lyre-like superstructure is pure ornamentation, which, perhaps, also serves as a lure or bait for insects, for they would readily see and fly towards the tipping knobs and, though they would be disappointed in them, they would quickly discover that there was honey all the same down below.

Our beloved and familiar pansies and violets (*Viola*) have quite an elaborate honey apparatus, different to any we have yet seen. On the backs of two of the dumpty stamens is a long slender hump, which has a

Fig. 10.—*Anemone Pulsatilla*. Here the lower rings of the stamens are dummies, having been transformed into nectaries.

honey sac at its extremity. These humps are both carefully enclosed in a velvet-like pouch leading off from one of the petals. Into this pouch the honey trickles, and it is to this reservoir that an insect must push its way if it would partake of the good things provided. In its passage thither it perforce knocks its head on the stigma and thus lets loose on to its back a little lot of pollen which was stored up behind it. This pollen is transferred to the stigma of the next flower visited, and thus, by acting as carrier, the insect pays for its feast.

In one of the anemones (*Anemone pulsatilla*) there is quite another scheme for a honey hiding place. Here the outer rings of the many apparent stamens are merely dummies and produce no pollen at all; instead they secrete nectar, and as insects sip the honey they become dusted over by the genuine adjacent stamens. This strikes one as a very 'cute arrangement.

To find honey on or in connection with the ovary or seed-box is far more uncommon, still it does occur there at times, as, for instance, in a ring round the seed-boxes

of the snapdragon (*Antirrhinum*) and of the wild convolvulus (*Convolvulus*).

A quite unique set of honey glands is found in the spurges (*Euphorbia*). On a little wall all round the insignificant and peculiar flowers are set crescent-shaped bodies which can be very distinctly seen by a careful observer. These are made of honey tissue, and the honey lies stickily on their upper surfaces. The curiousness of their appearance helps to lend a distinction to the flower which it otherwise lacks.

Again, honey is occasionally found quite outside the flower. On the stalks of cherry leaves, close to their base, are two red lumps the size of pin-heads. These are nectaries, though they are rarely looked upon as such. On the lower part of the leaf of a bean (*Vicia*) are a couple of honey glands, while the laurel leaves, too, provide quite a feast, round which the "contented hum of the bees" may be heard. Now we can easily see why the flowers provide honey and attract insects, but it is not quite so simple a matter to understand why these and other leaves should do so. It is suggested,

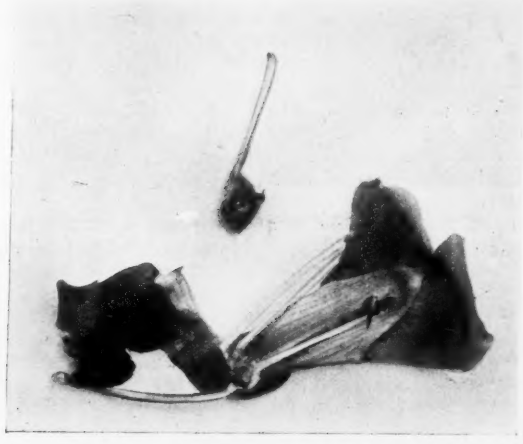


Fig. 11.—Snapdragon (*Antirrhinum*) flower torn open and the ovary lifted out. In this flower the honey is produced round the ovary wall.

however, that there are many small insects which creep into flowers, eat up the honey, and creep away again without performing the necessary office of fertilisation, owing to their small size. So various plants have provided this honey on or near their leaves to attract these unwelcome guests from the flowers. The honey is so obvious, so easily obtained, that they fall into the pleasant trap laid for them, and do not trouble the flowers. This is particularly the case with ants. Though no doubt the bees and desirable visitors likewise dine upon this outside honey, yet they will be attracted by the flower's untouched supplies and visit them also, having larger appetites to satisfy.

In certain cases, as in the sundew (*Drosera*), honey is used as a cruel lure. On the marshy hillsides the sundew's leaves glisten with sparkling drops, as the name implies. Flies—insects of all kinds—hasten towards the proffered banquet. They alight, but at their first touch the hairs which stand erect all over the leaves close over, and the victim is soon crushed to death and his body-juices absorbed by this carnivorous plant. But honey traps of this nature would fill a whole chapter to themselves, and this mention alone can be made of them now.

How much honey does a plant produce? Well, the amount differs enormously. Sometimes it is the merest suggestion of sweetness almost unnoticeable by us; at other times it is plentiful enough for a child to pluck the flowers and suck them; while, again, several large drops may exude, as in the Crown Imperial lily. At

Fig. 12.—The Spurge (*Euphorbia*) has curious crescent-shaped honey glands surrounding each insignificant flower.

the Cape there is a plant called melianthus—the honey plant—out of which honey literally pours like a little rain when it is shaken; and one of the orchids has two small horn-like spurs from which honey constantly drips until the lower cup-like petal is filled, perhaps to the amount of several teaspoonfuls.

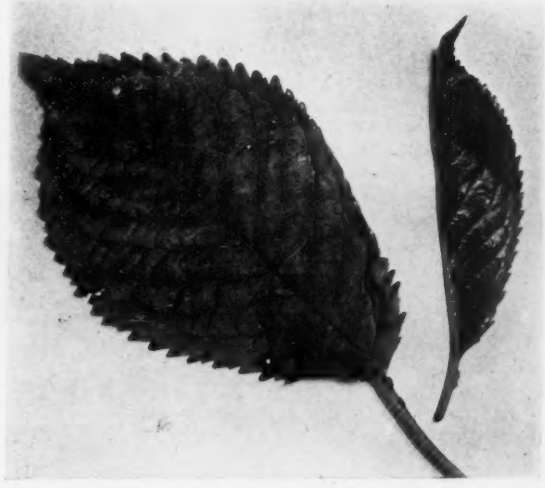


Fig. 13.—Nectaries are found on the leaf stalks of the Cherry.

Though more extraordinary nectaries and adaptions might be quoted from tropical floras, we have confined ourselves here to the common flowers of our gardens and fields because they are at the service of all who care to enquire for themselves into this aspect of Nature's wonderful works.

XUM

Some Novel Methods in Spectrum Analysis.

Binocular Spectroscopy.—Part I.

By W. MARSHALL WATTS, D.Sc.

THE use of both eyes in spectroscopy is a new departure, rendered possible by the invention of a binocular spectroscope, which stands in the same relationship to the usual monocular form of instrument as the binocular microscope does to the monocular; and as the

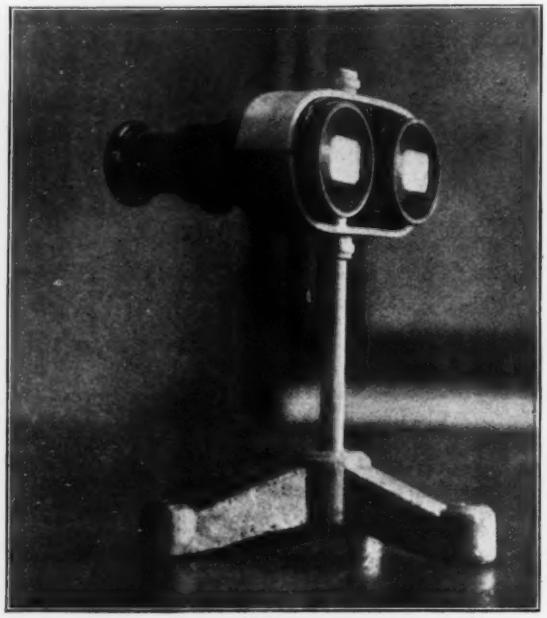


Fig. 1.

observer accustomed to the binocular microscope would not willingly go back to the other form—with low powers, at any rate—so we venture to assert no one who has tried the new binocular spectroscope will be content with a monocular, unless for some special purpose. The brilliancy, combined with excellent definition and large dispersion of the new instrument, as well as the economy effected by its adoption, render it an excellent instrument for demonstration and for the use of the amateur; although it will be found to be adapted for nearly all purposes for which a spectroscope is used, as well as having a special field of usefulness all its own.

To construct a spectroscope for two eyes by duplicating the ordinary arrangements of the monocular, slit, collimator, prism or grating, and observing telescope, is too cumbersome and expensive to be practicable. In the instrument we are describing there is no collimator, and (for many purposes) no slit, and the observing telescopes are simply a pair of opera-glasses. The instrument, in fact, consists of a good field-glass having attached in front of each object-glass a transparent diffraction grating mounted on optically-worked plane glass. The gratings are transparent replicas of Rowland gratings of 14,438 lines to the inch. The instrument on its stand is shown in Fig. 1. The gratings shown in the photograph cover only the central portions of the object-glasses, but four times as much light in the spectrum is obtained by using larger gratings covering the whole of the object-glasses. The presence of the gratings makes little or no difference to the ordinary use of the instrument as an opera-glass, but in order to see a spectrum the observer does not look *at* the source of light, but turns the instrument through an angle of about 12° to the right (or left) when the spectrum of the first order is seen; or on t rning through about 24° the spectrum of the second order, with the lines spaced twice as far apart as in the first order.

A peculiarity of the new instrument is that it is intended to be used without a collimator, and on luminous objects of sufficiently definite form, such as vacuum-tubes, without a slit. Fig. 2 shows the appearance of two vacuum-tubes as seen with the binocular in the first order. The two tubes were placed in the same vertical line; the upper one contained helium and the lower one hydrogen. The capillary of the tube forms a sufficiently definite line of light to give a good spectrum with the spectroscope about six feet from the tube, as, for example, in the red line of hydrogen seen at the left. The field of view of the opera-glass is so large that not only is the whole of the spectrum seen at once, but also the whole of the vacuum-tube, so that any differences between the different portions of the tube, if

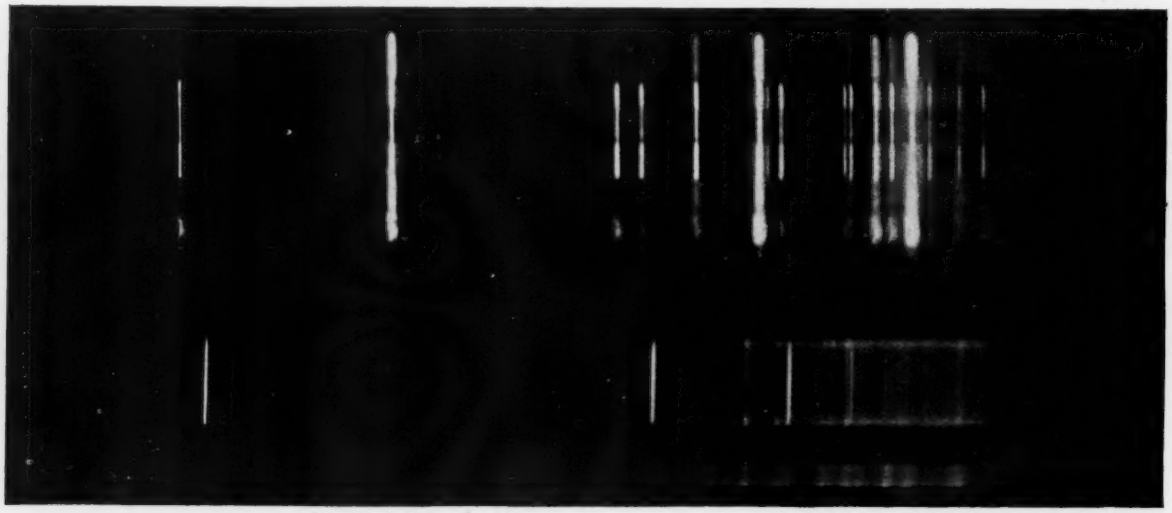


Fig 2.

such exist, become at once apparent. Differences between the positive and negative bulbs, and between these and the capillary are frequently observed. In Fig. 3, for example, the difference between the negative pole discharge in a nitrogen vacuum, and that from the positive pole is sharply marked. Fig. 4 represents the spectrum of a tube containing mercury with traces of hydrogen, carbonic oxide, and nitrogen. The fine line on the left is the hydrogen red line 6563.0, then the mercury double yellow line 5790.5 and 5769.6, then the mercury green line 5461.0 strongly marked; and between them the carbonic oxide band 5610.3 very faint; to the right of the mercury green line are seen the carbonic oxide band 5198.3, the fine mercury line 4916.4, then the hydrogen blue line (Hβ) 4861.5, followed immediately by the edge of the carbonic oxide band 4835.4; and at the right of the photograph are seen the blue bands of nitrogen, which will be recognised by comparison with Fig. 2.

All the brighter lines due to mercury can be picked out by their prolongation into the upper bulb; it may be noticed that while the positive bands of nitrogen are hardly seen in the upper bulb, the band at 3913.7 characteristic of the negative pole is nearly as strongly marked in the upper bulb as the mercury lines. This is the second of the strong images of the bulb, counting from the right; the first being the group of strong Mercury lines 3650.3, 3654.9, 3663.3. The presence of this band 3913.7, strongly marked in the upper bulb, shows that this was the negative bulb. With reference to the hydrogen lines it will be observed that they become thinner at the top, and show no sign of passing into the upper bulb. The lines of Balmer's series H α, H β, H γ, H δ, H ϵ, and H ζ can all be traced in the photograph at the respective wave-lengths 6563.0, 4861.5, 4340.7, 4101.8, 3970.2, and 3889.1.

It is extremely interesting to watch the changes which may be produced in a vacuum-tube by heating during the passage of the discharge, or by varying the pressure, if the tube is used attached to an air-pump. It is well known that tubes containing helium, argon, neon, &c., sooner or later become unserviceable by use, the gas becoming occluded by the electrodes or by the film of aluminium deposited on the glass, so that the vacuum becomes too great, the tube reaching the condition of an X-ray tube and only showing a green phosphorescence. Such a helium tube was opened, a little mercury introduced, and the tube re-exhausted and sealed. When first examined after this treatment, the tube showed only mercury lines together with the bands at 6079, 5610, 5198, 4835, 4511, 4393, and 4123 characteristic of carbonic oxide, this spectrum proceeding, no doubt, from dust which had found its way into the tube during the time it was open. On continuing to pass the discharge, the helium lines suddenly flashed out and the carbonic oxide spectrum faded, so that in one condition of the tube it showed again a good helium spectrum, the gas having been liberated by the action of the mercury on the film of aluminium. In this condition of the tube the mercury lines could easily be picked out from the helium lines, because they were brighter at the upper end of the capillary, the helium lines being brightest at the bottom, as if the discharge were handed on from the helium to the mercury.

On heating the tube with a Bunsen flame, the tube became intensely luminous, hydrogen made its appearance, the helium lines faded, and nothing but mercury and hydrogen was seen. It appears that a vacuum-tube does not always show the spectrum of all the substances which it contains, and that the brightest lines may even be those of an impurity present in very small proportion. (*To be continued.*)

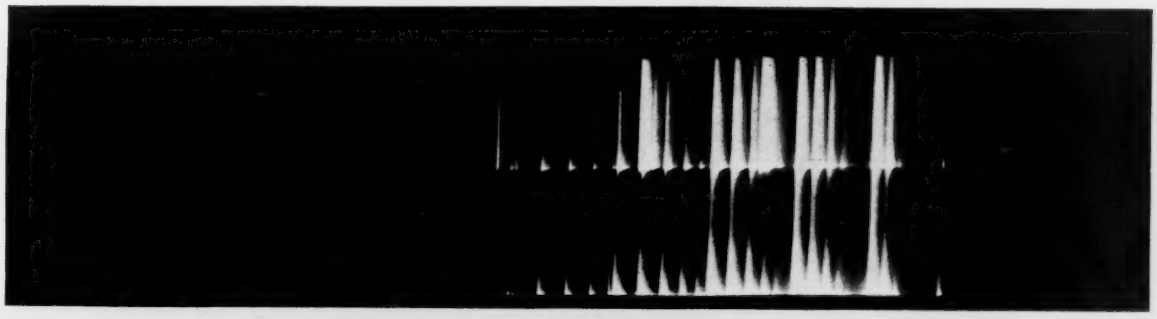


Fig. 3.—Discharge in a nitrogen vacuum. Negative pole at the top, positive pole at bottom.

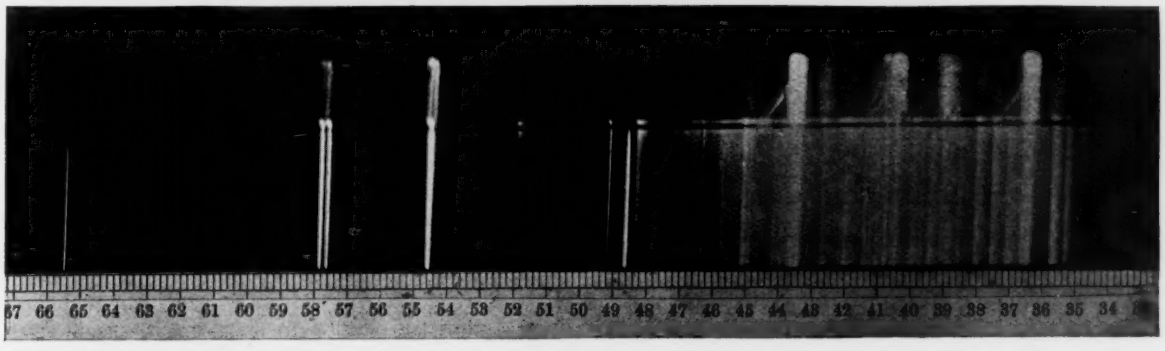


Fig. 4.

The Survival of Fish Heads.

By DR. ALFRED GRADENWITZ.

RECENT physiological researches have shown that the extinction of life is not an instantaneous, but a gradual process, affecting one after the other the various organs of the body. By convenient means this process can even be retarded and the organs may be temporarily restored to life even when death has apparently occurred.

As fishes are known to be especially tenacious of life, it seemed interesting to investigate these phenomena on this class of animals. This has been done by Professor Kouliabko, of Tomsk University, who, in a lecture recently held at the Heidelberg Physiological Congress, communicated the results of his investigations on the survival of fish heads.

In connection with some previous researches on the resuscitation of the heart, Professor Kouliabko had examined the behaviour of isolated fish hearts, especially lamprey hearts. However, after some experiments, these objects proved unavailable for physiological experiments, as the activity of isolated hearts, in which no artificial circulation is maintained, will cease rapidly, while the use of artificial respiration is rendered well-nigh impossible by the smallness of the object. He, therefore, began experimenting on the whole of the front or head part of the fish.

An artificial circulation was obtained in the fish head following the normal anatomical path of the blood without dissecting the heart, the ordinary Ringer-Locke solution saturated with oxygen being used as circulation liquid.

In order to introduce the canule, Professor Kouliabko used openings of the cardinal or hepatic veins through the cross section of the body, while in some cases the canule point was simply introduced into the auricle. This process is thus exceedingly simple, far more so than the method of artificial circulation in the case of frogs.

After withdrawing the fish from the water, it should be cut into two parts along a cross section perpendicular to the longitudinal axis of the body. After next dissecting the abdominal and thorax membranes of the front part, along the *linea alba*, and removing the left-hand membrane, both the ventricle and the free end of the gill cover (opercule) are provided with self-recording levers. The canule point is then introduced into the auricle of the hepatic vein and the circulation liquid is allowed to enter from a reservoir. The liquid arrives at the ventricle, in order thence to proceed through the gill vessels and the ramifications of the artery system to the brain.

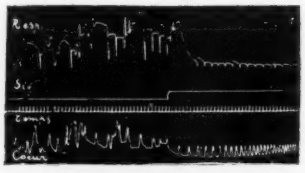


Fig. 2.

Fig. 1 gives a schematical view of a fish head thus prepared according to an original drawing by Professor Kouliabko. The heart with all its compartments and vessels is seen to be disengaged, while the liver and the hepatic veins (leading to the heart) are visible in the back part. At the front part of the ventricle is seen the white swelling of the *bulbus arteriosis*, and further on to the front, the gills. On a fish head treated in this manner the skull can be opened in order to disengage the brain and to stimulate or extirpate at will the various parts of the latter.

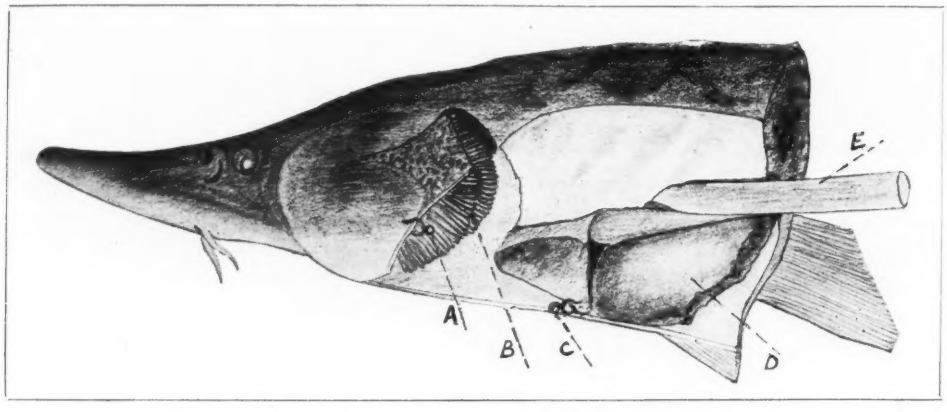


Fig. 1.—Sterlet Head, Prepared for Artificial Circulation.
A, clip fixed to bronchial gill; B, gills; C, clip fixed to ventricle; D, liver; E, canule introduced into a cardinal vein.

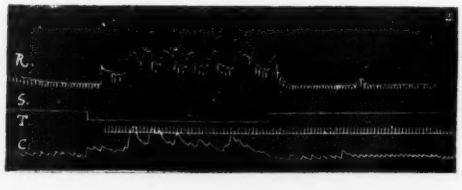


Fig. 3.

As soon as an artificial circulation is established in this dissected fish head, all the organs of the latter will begin working in a practically normal manner, though the fish is placed not in water, its habitual vital medium,

but in air, and though its vessels are traversed by an artificial serum instead of blood.

This artificial activity can be maintained for hours and will cease only gradually.

The recording levers attached to the ventricle and gills respectively are placed in contact with smoked paper, on which they draw some characteristic curves illustrating the results obtained by this method.

If the dissected fish head be observed without artificial circulation, asphyxia will be noted to develop immediately after the head has been severed from the body. The violent general convulsions observed at irregular intervals are obviously due to dyspnœa. The mouth being wide open, the gills are seen alternately to open and close; the heart will beat very slowly and irregularly, and sometimes will come to a perfect standstill.

The curve characteristic of this stage is seen in the left-hand part of curve No. 1.

If now the cock of the supply pipe being opened, the circulation liquid be allowed to enter, these phenomena are seen to change nearly instantaneously. Instead of general convulsions, quite regular respiratory movements of the gill cover (*operculum*) will now be noted, while the activity of the heart at the same time becomes more frequent and regular. This is seen in the right part of curve 1.

From the very lively symptoms of dyspnœa observed during a circulation of Locke solution saturated with carbonic acid, it is inferred that the respiratory centre of fishes possesses the capacity of being excited immediately by the composition of the surrounding medium, which contradicts the hypothesis according to which the respiratory centre of fishes would possess only a reflex function.

Solar Disturbances during March, 1908.

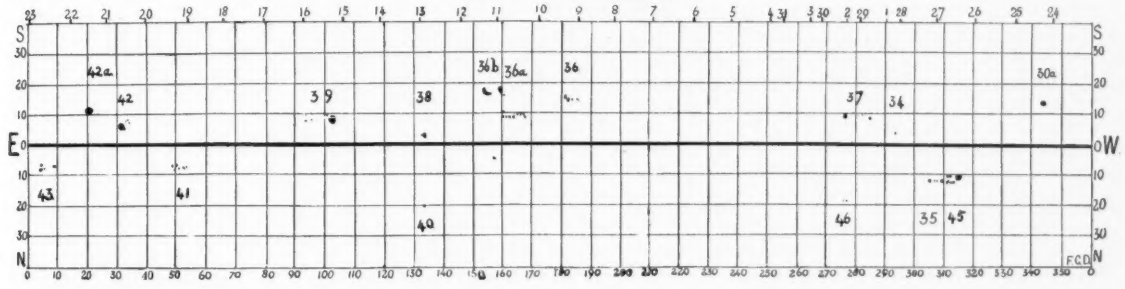
As in previous months, the chart gives the results of the observations of Messrs. J. McHarg, A. A. Buss, and F. C. Dennett. The longitude of the central meridian on March 1 was 290° 17′.

No. 30*a* is repeated from last month.

No. 34.—A pore, seen only 2nd, in disturbed area near centre of disc. Mr. McHarg recorded aurora on 1st.

No. 35.—Two spotlets and a pore surrounded by faculæ, 4th-5th.

DAY OF MARCH.



No. 36.—A spot 7,000 miles in diameter surrounded 4th to 7th by changing pores. Difficult gray pores preceded it 9th, more evident 10th, but pores and spot not seen after.

No. 36*a*.—A group of pores 9th-11th, 12th to 14th like two tiny groups.

No. 36*b*.—Two spotlets 15th, much larger 16th and 17th, when one was quite 12,000 m. in diameter.

No. 37.—At first a small spot and spotlet, with pores afterwards opening between them. 5th-7th.

No. 38.—A solitary spot 7th to 15th, except on 12th, when a tiny companion showed close east. Close to place of No. 26.

No. 39.—At first a group of pores and spotlets, on 12th-15th. The *p*. spot increased to 22,000 miles in diameter. The group after 15th composed of spotlets only, showing continual alteration. 10th-21st.

No. 40.—A pore only seen 12th.

No. 41.—A spot 11,000 miles in diameter, alone 14th-17th, a pore North on 18th, only 7 or 8 pores and spotlets, constantly changing 19th-22nd. On 23rd only one pore left in a disturbed looking area.

No. 42.—A spot 14,000 miles in diameter, solitary 15th to 18th, four pores preceding, and umbra bridged 19th, one on 21st, three 22nd, two spotlets 23rd, but only one attendant pore 24th. 15th-25th.

No. 42*a*.—A spot 14,000 miles in diameter in evident connection with No. 42, both by the appearance of faculæ and the evidence of the spectroscope. Two tiny companion pores 17th, and one on 21st, otherwise the big spot was alone. 15th-24th. These two spots are the remains of No. 32.

No. 43.—A triangular group of pores, 18th-22nd, in area of No. 15.

No. 44.—A group of three hazy pores, one rather larger, longitude 0° 19′, latitude 70° south, only seen 21st.

No. 45.—At 11 a.m., 27th, only two pores seen, at 3.15 p.m. it was a group of at least eight spotlets and pores, the leader afterwards increased to 10,000 miles in diameter, with a bridged umbra. The group was very active telescopically, and still more so spectroscopically. 27th March-1st April.

No. 46.—A group of pores only marked in approximate position as it was not measured. 27th.

There was another disturbed area, though spotless, on the other side of the equator from No. 45. The transit of these over the central meridian was marked by brilliant auroral glows, 26th-27th, and a marked disturbance of the magnets at Stonyhurst, March 26th, 5.15 p.m., to 27th, 8 a.m., and again from 4 p.m. until 28th, 7 a.m. We are indebted for this last information to the magnetogram tracings kindly forwarded by Rev. W. Sidgreaves, S.J., F.R.A.S., the Director of that Observatory.

XUM

Photography: Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

Autochrome Plates.

Since referring to these plates I have had some exceptional experience with them, those dealt with having been received not later than last November. A microscopic examination of three different samples showed in each case that the starch grains were distorted to a certain extent, doubtless by pressure, and that a black powder had been applied to fill up the spaces between them. In one case the black powder had stuck also on the top of the starch grains, while in the other two samples it encroached to a comparatively slight extent on the area occupied by the starch. In neither of the three cases were the interstices completely filled, but the spaces occupied by neither the starch nor the black powder formed a very small proportion of the total area. In each case the patches of colour were clearly visible to the naked eye, because of the grouping together of the red, the green, and the blue grains; indeed, it seems impossible to thoroughly mix them.

The plates I had, though quite good at first, had deteriorated to a useless condition in a little more than three months, the sensitive layer giving spots and markings of different kinds. I exposed one on a coloured diagram, and treated it according to the full instructions of Messrs. Lumière. It proved to be under-exposed, therefore the contrast was poor and the colours were dull, and there was a deposit of silver over the whole surface. On the following day I treated it to the ordinary hypo. and ferricyanide reducer until the silver was dissolved away from the white parts of the diagram. This left little more than the ghost of an image. After drying the plate I worked up this image to good density by intensifying it four times successively by the mercury and ferrous oxalate method, without intermediate drying. The whole treatment occupied about an hour and a half. This included, of course, eight washings, and each of these was of six or seven minutes' duration. The plate stood this treatment perfectly, showing no other sign of giving way than a slight frilling at the edges that did not extend beyond the part covered by the rebait of the dark slide. When dry, the loosened edge of film was scraped away and the plate varnished. The colours are good, a slightly pinkish tint of the whites being obviously due to the preponderance of red grains in the starch layer, as there is no deposit of silver in this part. This experiment shows not only to what extent these plates can be safely manipulated, but proves that the short washing recommended by Messrs. Lumière, about five minutes, is sufficient, for the repetition of the mercury and the ferrous oxalate method of intensification is a good test for the thoroughness of the washing. If the mercury salt and the ferrous oxalate, in turn, had not been thoroughly removed, the plate would have become fogged or stained. Ordinary tap water was used throughout, and this led to the usual slight deposit of calcium oxalate. Rather than running the risk of removing this by a hydrochloric acid bath, which is generally the best method to follow, I merely varnished the plate as specified by Messrs. Lumière. Deposits of calcium oxalate entirely disappear when a plate is varnished.

The Action of Mercury and its Compounds on Photographic Plates.

The action of metallic mercury and some of its salts on photographic plates has been investigated by R. de J. F. Struthers and J. E. Marsh (Jnl. Chem. Soc. Trans., 1905, p. 377), and more recently by K. Kof and H. Haehn (Zeit. Phy. Chem. 1907, p. 367). Further work will have to be done concerning the effect of mercuric chloride when placed at a short distance from a gelatino-bromide plate and left in the dark for a few hours, as Messrs. Struthers and Marsh found the mercury salt to be very active under these conditions in making the silver salt of the plate developable, while Messrs. Kof and Haehn find that there is no action at all, and that if the mercuric chloride is dissolved in water (or other solvent) and the plate is supported a short distance above the solution, the plate is affected, but in an opposite sense, that is, development is retarded, or if the developable condition has been produced it will be undone or reversed where the vapour has acted. There appears to be no doubt from Messrs. Kof and Haehn's experiments that it is the vapour of the mercury salt that produces the result, for it has long been known that mercuric chloride is freely volatile with steam when its solution is heated, and these investigators show that it volatilises slowly from its solution even at the ordinary temperature. They find, too, when a solution containing mercuric chloride and stannous chloride (which is itself inactive) is employed, that as the tin salt reduces the mercury salt to the metal, the solution gives off a vapour that renders the silver salt of a plate developable, and that, moreover, is able to reduce mercuric chloride to calomel. One might think that in this case it is the vapour of metallic mercury that produces the results, but mercury has been repeatedly found to be without effect upon photographic plates. Messrs. Struthers and Marsh found that solid mercuric cyanide behaved as they found mercuric chloride to, in rendering silver bromide developable, except in the case of a very old sample, or recently heated samples. In the latter case a trace of mercuric chloride or the addition of a little water restored the activity. Many other salts of mercury were tested and found to be without effect, except mercuric bromide which rendered the plate developable. The investigators in both these communications refer to radiations and emanations, but as these words have acquired more or less restricted meanings, I submit that it would be better not to use them until there is some definite evidence that the results are not due to the simple volatilisation of the material employed, or perhaps of an accidental constituent of it. Until the facts are established, it is a waste of words to trouble about any theoretical significance that they might have.

New Apparatus.

"Cooke" Lenses, &c.—Messrs. Taylor, Taylor, and Hobson, of Leicester, are prepared to send their new catalogue to any applicant. It describes, among other things, the several series of "Cooke" lenses and the very compact reflex camera, to which I referred a few months ago. The prices of the "Cooke" lenses of larger aperture are reduced, and a new lens, the "Primoplane" Cooke, is described, which covers a wide angle at large aperture. Though of only 5 inches focal length, it covers a half-plate at *f*/6.5, and a whole-plate at *f*/16, and its price is no higher than the

lens of similar focal length and aperture that includes only an ordinary angle.

Goerz Pocket Tenax Camera.—I have recently examined a quarter plate example of these cameras. It will really go into a pocket of ordinary size, and is opened ready for use by merely pressing a concealed button, thus allowing the base to fall into position, when the lens with its shutter is immediately drawn forward by a small spring roller to the infinity focussing mark. An extending base gives focussing range enough to use one combination of the lens alone, or to photograph a near object full size. The camera is excellently made and has all desirable adjustments, although it is so compact and moderate in price.

CORRESPONDENCE.

Research Defence Society.

SIRS,—A Society has been formed, with the name of the Research Defence Society, to make known the facts as to experiments on animals in this country; the immense importance to the welfare of mankind of such experiments; and the great saving of human life and health directly attributable to them.

The great advance that has been made during the last quarter of a century in our knowledge of the functions of the body, and of the causes of disease, would have been impossible without a combination of experiment and observation. The use of antiseptics, and the modern treatment of wounds, is the direct outcome of the experiments of Pasteur and Lister. Pasteur's discovery of the microbial cause of puerperal fever has in itself enormously reduced the deaths of women in child-birth. The nature of tuberculosis is now known, and its incidence has materially diminished. We owe the invention of diphtheria anti-toxin entirely to experiments on animals.

The causes of plague, cholera, typhoid, Mediterranean fever, and sleeping sickness have been discovered solely by the experimental method. Not only have a large number of drugs been placed at our disposal, but accurate knowledge has replaced the empirical use of many of those previously known.

The evidence before the Royal Commission has shown that these experiments are conducted with proper care; the small amount of pain or discomfort inflicted is insignificant compared with the great gain to knowledge and the direct advantage to humanity. While acknowledging in general the utility of the experimental method, efforts have been made by a section of the public to throw discredit on all experiments involving the use of animals. The Research Defence Society will therefore endeavour to make it clear that medical and other scientific men who employ these methods are not less humane than the rest of their countrymen, who daily, though perhaps unconsciously, profit by them. The Society proposes to give information to all enquirers, to publish *précis*, articles, and leaflets, to make arrangements for lectures, to send speakers, if required, to debates, and to assist all who desire to examine the arguments on behalf of experiments on animals. It hopes to establish branches in our chief cities, and thus to be in touch with all parts of the kingdom; and to be at the service of municipal bodies, hospitals, and other public institutions. The Society was formed on January 27, of the present year, and already numbers more than 800 members. It is not an association of men of science or of medical men alone; its membership has been drawn from all departments of public life, and includes representatives of every class of educated Englishmen and Englishwomen, including many who have taken an active part in the prevention of cruelty to animals. This fact is in itself a remarkable protest against the attacks which have been made on the researches that the Society has been formed to defend.

The annual subscription is five shillings to cover working expenses; but larger subscriptions, or donations, will be gladly received. The acting Hon. Treasurer, *pro tem.*, is Mr. J. Luard Pattisson, C.B. (of the Lister Institute); and an account in the Society's name has been opened with Messrs. Coutts & Co., 440, Strand. The Hon. Secretary is Mr. Stephen Paget, 70, Harley Street, W., to whom all communications should be addressed.

Yours, etc.,
CROMER (*President.*)

Pearls.

SIRS,—In last month's issue of "KNOWLEDGE," there was a note on *Placuna placenta* (page 82), an oyster, from which pearls were said to be obtained in Ceylon. Perhaps a little more information about this bivalve may be interesting to your readers. It is found abundantly along the west coast of India as far north as Sind, and is collected for the sake of the pearls which it commonly contains. It differs greatly from the true pearl oyster not only in appearance, but in habit. A full-grown *Placuna placenta* is a pair of roughly circular plates, measuring about 6 inches in diameter. They are thin and white, the inner surface of each being pearly, and the outer rough and laminated, but often suffused with a lovely pink iridescence. The upper shell is slightly concave on the inside, and the lower slightly convex, so that, when they are fitted together, it appears as if no space at all were left between them. There is enough, however, for the accommodation of the thin, flat mollusc. They are found lying unattached on muddy bottoms, in creeks and estuaries, at a depth of a few feet, and occur in enormous numbers in certain areas during certain years. It seems probable that they have some power of motion, like the scallop shell (*Pecten*). About five per cent. of the mature shells are said to contain pearls, which lie loose between the mollusc and the shell. They are small and often misshapen, so that only the best of them are fit for the purposes of the jeweller; but they are worth nearly £2 per ounce all round, having a high place in the mysteries of Indian medicine, and also yielding, when calcined, the finest quality of the black powder with which Indian beauties enhance the lustre of their eyelids. At Kurrachee, in Sind, these pearls are a Government monopoly, inherited from the Mirs, and the right to collect them is farmed out. The amount realised has varied from less than £100 to more than £600 a year. The work of collection is attended with none of the dangers and difficulties of diving for true pearls. When the tide is well out, naked fishermen paddle about the creek in their canoes, and dropping into the water in likely places, where it is not more than breast deep, feel for shells with their toes, with which they also bring them up, for these people have prehensile feet, like apes. When the canoes are full they are paddled to a bank where the farmer's men sit opening the shells one after another, and feeling with their thumbs among the soft vitals of the molluscs. The shells are thrown aside, and form extensive adoriferous banks.

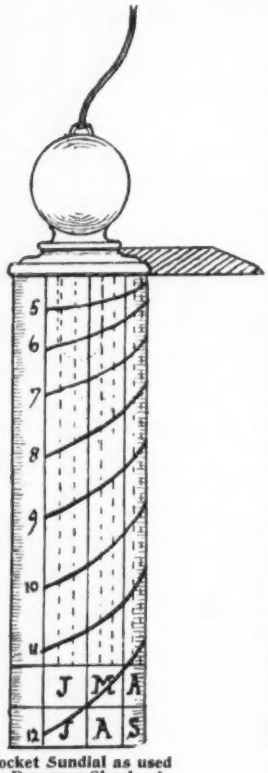
This shellfish is commonly known in India as the window oyster, from a use to which it was put in the early days of our rule in that country. When our only means of communication with the East was by ships sailing round the Cape of Good Hope, and taking half a year to the voyage, glass in every form was expensive, and a convenient substitute was found in the shell of the window oyster. Window frames were made with narrow laths, in parallel rows, a few inches apart, and grooved on both sides. Then the shells, cut into squares, were slipped in between the grooves, overlapping each other and producing a pretty effect. They were not transparent, but quite translucent, and combined brightness with privacy, like frosted glass. It is on record that, when the present Bombay Cathedral was built, in the beginning of the 18th century, its windows were paned with these shells. We have now quite given them up, but they are still in common use in Goa, the famous capital of the Portuguese possessions in India.

Yours, etc.,
Edinburgh. E. H. AITKIN.

XUM

Portable Sundials.

SIRS,—The interesting account by Dr. Gradenwitz, in your last issue, of a portable sundial, by means of which our central luminary might be restored to public favour as a general timekeeper, recalled to my mind a simple little contrivance for roughly telling the time of day, which is, I believe, in use amongst the shepherds of the Pyrenees, and a specimen of which was shown to me some years ago by a friend who had obtained it whilst travelling in that region. This "pocket sundial," consists of a small wooden cylinder, with a movable top, to which is affixed a metal style, which latter, for convenience in carrying, can be closed like a knife-blade into the body. The whole instrument, as will be seen by the annexed drawing, is of the simplest possible construction. The months, which are figured on the circle at the base, have each three date-marks—*e.g.*, January 10, 20, and 31—so that when all the hour-marks have been placed opposite to their respective dates, a continuous curve joining the corresponding hour-points serves to find the time for a day intermediate to those set down, the movable top being turned until the style occupies a proper position between the two divisions. All, then, that is necessary when putting the apparatus to its use, is to turn the top so that the style is opposite a certain date, and hold the instrument by the attached cord in such a manner that the shadow of the style falls exactly on the vertical line below it. The extremity of the shadow will then mark the hour with a degree of precision in all probability quite sufficient for the very simple requirements of the users of such a primitive form of sundial.



Pocket Sundial as used by Pyrenees Shepherds.

Speaking of sundials, I should add that in Florence, which, as I pointed out in "KNOWLEDGE" for December, 1905, enjoys the distinction of possessing one of the loftiest gnomons in the world, very many of these interesting "time-machines" are to be found attached to the walls of mediæval palaces and villas, and on many of the dials the equation of time has been duly considered; that is, in many instances the style is provided with a perforated disc, so that the actual time indicator is a spot of sunlight, which, by its seasonal change of position along the figure 8 curve marking the meridian, shows the time of mean noon with all reasonable accuracy. Yours, etc.,

W. ALFRED PARR.

Florence, Italy.

Aeronautical Supplement.

OWING to the increased size of the Aeronautical Supplement, which has been found necessary owing to the interest shown in the subject, certain alterations will in future be made as regards the combined subscription to "KNOWLEDGE" and "AERONAUTICS," details of which may be found in the advertisement pages of this issue.

NOTES.

ASTRONOMY.

By CHARLES P. BUTLER, A.R.C.Sc. (Lond.), F.R.P.S.

Jupiter's Eighth Satellite.

CONTINUED observations of the moving object observed near Jupiter by Mr. Melotte, of the Greenwich Observatory staff, has confirmed the first supposition that it was a new satellite. The body has also been photographically recorded at the Lick Observatory and by Dr. Wolf at Heidelberg. It is slightly brighter than J. VII. Details are given of the measured positions relative to Jupiter from 1908, January 27, to March 23, and on analysis it is found that these positions may be satisfied on the assumption that the new satellite has a retrograde orbital motion; the co-ordinates of the pole of its orbit plane are RA = 334° 48′; N.decl. = 56° 44′; distance from Jupiter = 0·24 of an astronomical unit; daily motion about Jupiter 0°·266. It passed the minor axis of the apparent ellipse on February 18.

Approaching Return of Halley's Comet.

As the result of further investigation on the perturbations of Halley's Comet, Mr. A. C. D. Crommelin announces that he now considered the most probable date of return to be 1910, April 8, about six weeks earlier than the value given by de Pontécoulant, the error of the latter probably arising from his erroneous value of the mean motion. The early history of the Comet has been traced, and the returns of 1301, 1222, 1145, and 1066 satisfactorily confirmed. The Comet would make a close approach to the earth early in May, 1910, and for some days after that it should be a fine object in the evening sky; as, however, its declination would be south of that of the Sun, it would be more favourably situated for observers in the southern hemisphere.

Harvard College Observatory Report for 1906-7.

Professor E. C. Pickering's sixty-second report of the Astronomical Observatory of Harvard College deals with the work for the year ending September 30, 1907. With the *East Equatorial* nearly thirteen thousand photometric comparisons have been made by O. C. Wendell, a large part of this series relating to stars of the Algol type, for determining their light curves and times of minima. Numerous other measures have been made of various asteroids, stars of fourth type spectra, and Jupiter's satellites. With the 12-inch *Meridian photometer*, the Director has made 37,140 settings on 87 nights. No new programme has been formed for this work, as it is hoped to greatly improve the character of the observations when the 60-inch reflector is got into working order.

The results of the 4-inch Meridian photometer settings, formerly scattered through eight volumes of the "Annals," have been collected into a single volume, called the "Revised Harvard Photometry," giving the magnitudes of all the bright stars from the North to the South Pole. It will also furnish details of the spectrum type of each star.

With the 11-*inch Draper telescope* 356 photographs were taken, and with the 8-*inch* 611 plates. At the Arequipa station 429 photographs were taken with the 13-inch Boyden telescope, and 961 with the 8-inch Bache instrument.

The Bruce photographic telescope was employed for obtaining records of very faint objects, 372 plates being taken during the year. These are used for the determination of photographic stellar magnitudes, by photographing two regions on the same plate, under precisely similar conditions. A number of the regions selected by Kapteyn have also been photographed with exposures of 120 minutes. From these plates about 1700 new nebulæ have been found. The work of the *Blue Hill Meteorological* Station has been continued under the direction and at the expense of Professor Rotch, the prin-

cipal observations being investigations of the upper air by means of kites. Co-operation has been established with the observatory of the Rev. J. H. Metcalf, who has applied a new method of detecting faint asteriods with great success.

Professor Pickering makes an urgent appeal for funds in order to build a fire-proof structure for the unique astronomical library possessed by the Observatory. There was a serious fire in the residence on March 4, 1907, so that the danger is a very real one.

Spectrum and Brightness of Nova Persei.

Professor J. Hartmann describes the conclusions he has been able to formulate from his recent observations of the body now representing Nova Persei. For this work he designed a new spectroscope having a collimator objective of 40 mm. aperture and 60 c.m. focal length, made of ultraviolet glass, two right and left handed quartz half-prisms of 30°, and a camera objective of quartz, 40 mm. aperture and 32 c.m. focal length. With this apparatus attached to the 80 c.m. refractor, he obtained an excellent photograph of the Nova spectrum on October 15 and 18, 1907, with a total exposure of 8¼ hours, the magnitude of the star being 11·4. The spectrum obtained was found to be very similar to that of the Wolf Rayet star B.D. 35° 4001. The line λ4688 is the strongest in both spectra, while the fairly strong Wolf Rayet line λ4618 is comparatively faint in the Nova. The nebula lines, which were very strong during the first part of the period of decline, are now very faint or absent.—*Astronomische Nachrichten Bd.* 177 *No.* 4232, *Feb.* 8, 1908.

The Metron Star Finder.

By the kindness of Mr. C. Baker, 244, High Holborn, we have had the pleasure of examining an interesting novelty for assisting observers in the identification of celestial objects. The instrument consists of a miniature celestial globe arranged on a telescopic tripod stand, with screw adjustments for latitude inclination, and divided metal hour circle. A magnetic compass and spirit level are provided for completing the adjustment. This is oriented and fixed in the usual way. A light bar framework is then attached to the globe by means of three spring claws, and part of this frame is so constructed that two lenses are held in such positions that their mutual optical axis is always parallel to a line joining the centre of the sphere to the end of a metal pointer at the intersection of the three claw holders. This being so, it is evident that if the globe is in adjustment, and the pointer set on any star, the same star will be visible in the small finding telescope alongside. The magnifying power of the telescope sight is about *two*, and it has a fairly large field, so that no difficulty is found in placing it rapidly on any desired object.

The apparatus has also several additional uses besides a star finder which will render it useful to many interested in astronomical observation. By simply loosening the clamping nut under the hour circle, the apparatus can be rotated and the object thus kept under observation, as the whole instrument practically then becomes an equatorially mounted telescope without clock. A useful feature also is the provision of extra blank globes, which can be obtained by those wishing to keep records of the motions of planets, comets, the moon, &c.

The instrument is so self-contained that it even includes a small accumulator and electric lamp with switch, so arranged that the area of the globe round the index pointer is quite clearly illuminated. Teachers should find this apparatus of great use to them in their practical lessons in astronomy. Price complete, with telescope lenses, electric light and battery, compass, level, and tripod, in stout card case, £2 12s. 6d.

New Sketch Map of the Moon.

A new map of the chief lunar features has been issued by Mr. W. Porthouse, of Manchester. The disc is twelve inches in diameter, and represents the formations as seen in an inverting telescope. Each feature is numbered, and an index giving the corresponding name is appended on the side of the same sheet. The whole is very distinct and easily readable by a small lamp. It would probably have added materially to the usefulness of the map if the chief dark features of the moon's surface, such as the seas, had been either shaded or indicated with a dark wash; when this is done it provides more definite landmarks for the recognition of the smaller features.

Planispheric Curves.

Messrs. Zeiss send us a very useful addition to the *Sun and Planet* Chart noticed a few months ago, consisting of a transparent celluloid plate figured with a series of curves drawn to represent the horizon and prime vertical boundaries for various latitudes. By applying this plate to the chart, the sidereal times of risings and settings can be approximately determined, and also the sidereal times of transit over the prime vertical. The equator on the celluloid plate being placed to coincide with the equator on the chart, the plate is then moved parallel to the equator until the particular group of objects to be observed is covered by the horizon curve corresponding to the latitude of the station. The sidereal time required is then read off from the lower divisions on the margin of the chart situated in the middle of the horizon table. This can then be transformed into mean solar time if so desired.

BOTANY.

By G. MASSEE.

Origin of the Flora of South Africa.

DR. SCHÖNLAND has given an interesting study of some facts and theories bearing upon the question of the origin of the angiospermous flora of South Africa in *Trans. S. Afr. Phil. Soc.* In dealing with the flowering plants of South Africa it is recognised at once that there is one region, the south-western region of Cape Colony, which stands apart from other regions, and it is the peculiar types of this region that have mainly been taken into consideration in speculations on the origin of the flora of South Africa. Nearly fifty years ago Sir Joseph Hooker indicated the affinities of the South African Flora with that of Australia, as represented by the abundance in species in both countries belonging to Proteaceae, Compositeae, Irideae, Ericacea, Rutaceae. These and several other orders are far more abundantly represented in South-West Australia and South Africa than in any other part of the world, although their genera are almost unexceptionally different in the two countries. Many of the types restricted to South-West Cape Colony are considered beyond doubt to be of great antiquity. No evidence of a glacial period has been discovered in South Africa later than Permian times, and it is considered improbable that the extreme differentiation of plants found in South Africa could have been accomplished since the last glacial period of the Northern hemisphere. The author considers that the climate of South Africa has not altered materially since Upper Cretaceous times. Another evidence of the great antiquity of the flora is its ability to push outward into every dry valley of neighbouring regions, along with its strength to resist foreign invaders, the only plant which has successfully invaded the region being a species of *Opuntia* from the drier parts of Mexico and Central America.

There are undoubtedly strong connections between the Flora of South Africa and the Flora of southernmost South America, but they are by no means so strong as with the Flora of Australia.

The theory formulated by the author is as follows:—

"At the time when these common types developed, probably in Lower Cretaceous times, possibly even in Jurassic times, there was still a direct land connection between Australia and South Africa, that some of these types were carried to South America by a later connection with Australia, and that, on the other hand, tropical Africa was able to exchange types of animals and plants with tropical America up to early Tertiary times, and that in this way a second connection between the Flora of South Africa and the Flora of America was established."

There seems to be no way of escaping the conclusion that in late Mesozoic times, possibly up to the Cretaceous period, there was still a more or less distinct land connection between South Africa and Australia. Apart from purely geological evidence, this is supported by the distribution of the *Glossopteris* flora, as indicated by Arber.

The connection between South Africa and South America is shown very plainly in the numerous Gamopetalæ, and this may also be an indication that it has existed into Tertiary times. Species belonging to Hydrophyllaceae, Lentibulariaceæ, Gesneriaceæ, Bignoniaceæ, Solanacae, &c. Many

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species belonging to Cyperaceæ are also common to Africa and America. The conclusion is arrived at from phytogeographical considerations, that there was a double land connection between the South African Flora and the Flora of South America, one by way of Australia, accounting for the relations of the Flora of Cape Province chiefly with southern South America, and one by way of tropical Africa, accounting for the relations of the Palaeotropic South African plants with the Flora of tropical America. This land connection is accepted as a reasonable hypothesis by numerous zoologists and geologists.

After submitting further evidence, the author states that, "we may take it for granted that, at all events until Eocene times, an interchange of plants between tropical South America and South Africa, by way of tropical West Africa, was possible, and that thus some curious phytogeographical relations become intelligible."

On the part played by Bacteria in the development of certain Myxomycetes.

The researches of E. Pinoy, embodied in a thesis, show that the development of *Dictyostelium mucoroides* is dependent on the presence of certain bacteria. Even germination cannot take place in their absence. Cultures that appear pure are where the bacteria have disappeared, as the latter do not remain during the development of the *Dictyostelium*. The association of bacteria have been shown to be necessary in the case of three species of the Acrasieae, two of the Endomyxeae, and for *Plasmodiophora brassicae*.

The Myxomycetes are parasitic on colonies of bacteria. In the plasmodial condition the constituent amoeboid bodies of the myxomycete absorb and digest the bacteria in their vacuoles, by the aid of an enzyme somewhat similar to starch diastase. The Myxomycetes induce certain biological changes in the associated bacteria; *Bacillus fluorescens*, var. *liquefaciens*, loses the power of causing fluorescence in a nutritive solution or on gelatine.

The pigment of certain bacteria impregnates the protoplasm of the myxomycete during certain periods of development, and it is difficult to distinguish between the true coloration of a plasmodium, and the colour imparted by the bacteria.

The End of a Famous Oak.

The *N.B. Agriculturist* records the toppling over of the famous oak tree on the Marquis of Tweeddale's estate of Yester, East Lothian. The trunk had a girth of 15 feet, and was of great height. It was estimated to contain about 400 cubic feet of timber, and to date back to the union of the crowns of Scotland and England. The tree was situated on the way to the far-famed Goblin Ha' of Marmion, and was familiar to visitors.

CHEMISTRY.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

The Proportion of Iron in Bone Marrow.

DR. GLIKIN has recently published the results of his investigation of the proportion of iron in the marrow of the bones of various domestic animals and of man, and has come to the conclusion that the younger the animal, the greater the proportion of iron. Thus, in the case of a new-born pig, the amount of iron in the marrow was 1.15 per cent., while the amount was only 0.30 per cent. in a pig six weeks old, 0.15 per cent. in one of eight weeks, and was no more than 0.03 per cent. in full-grown animals. Similarly, a new-born puppy yielded 4.35 per cent. or iron, a dog of five weeks, 0.44 per cent., a dog of ten weeks, 0.32 per cent., and a full-grown animal 0.05 per cent. An analogous decrease in the proportion of iron also occurs in the liver. For instance, in the case of rabbits, the proportion of iron in the cells of the liver falls from about 10 per cent. to about 0.4 per cent. during the first three months after birth, while the liver of a new-born calf contains about seven times as much iron as that of a cow. There is some doubt as to the form in which the iron is present in the marrow, but it appears to be in combination with the complex organic phosphorus compound known as lecithin, which is one of the most important constituents of the substance of the brain and of the yolk of egg. The ratio of iron to phosphorus in the marrows agreed closely in many cases with that required for a compound containing one atom of iron combined with three molecules of lecithin, and the proportion of iron was found to decrease in almost the same proportion as did the lecithin during the growth of the animal.

The Edible Seaweeds of Hawaii.

There are upwards of 70 species of edible seaweeds growing on the coasts of Hawaii, and about 40 of these are in common use by the natives. Seeing that Japan derives a large income from the economic utilisation of its algæ, it is suggested by Mr. M. Reed, of the Hawaiian Agricultural Experimental Station, that the edible seaweeds of Hawaii might be used in like manner as the raw material for the manufacture of gelatine, glue, starch, etc. At present the algæ, which are known locally as *limu*, are only cultivated in a crude fashion, and are chiefly used in the form of salads. They contain a large proportion of phosphates, chlorides, bromides, and iodides, and are rich in starch and other carbohydrates. Three typical species examined by Mr. R. A. Duncan, contained, when dried by exposure to the air, 12.8 to 18.7 per cent. of water, 5.6 to 14.87 per cent. of proteins (gelatine), etc., 50.8 to 61.4 per cent. of carbohydrates, 0.19 to 2.98 per cent. of crude fibre, and 15.6 to 17.8 per cent. of mineral constituents. Experiments showed that these *limus* yielded satisfactory preparations of commercial glue and gelatine.

A Curious Locomotive Boiler Deposit.

Mr. T. U. Walton, of Sydney, has published an account of a remarkable deposit found in the brass tubes of a small locomotive that had been working for some time. It was in the form of a dense black scale, thicker than the walls of the tubes, and similar to gas-black in appearance. On analysis, it was found to consist of 88.89 per cent. of fixed carbon, 2.98 per cent. of volatile hydrocarbons, and 8.13 per cent. of ash. As the ash in the coal used was about 4 per cent. higher than that of the deposit, coal dust could only have been the source of part of the deposit, the remainder probably consisting of gas carbon derived from the condensed hydrocarbons. A considerable loss of heat would probably result from this coating of the tubes with a thick layer of a material of low heat-conductive power. In experiments made in the University of Illinois, by Messrs. Schmidt and Snodgrass, it was found that the loss of heat with a scale $\frac{1}{8}$-inch thick was from 10 to 12 per cent., or considerably less than was anticipated. A further conclusion arrived at was that the structure of the deposit had far more influence than the thickness upon the loss of heat, and that the chemical composition was only of importance in this respect in so far as it influenced the structure.

An African Fish Poison.

A powerful fish poison used by the natives of the Ivory Coast is prepared from the fruit of the plant, *Strychnos aculeata*, the active principle of which is so toxic that the addition of one part of the fruit to 10,000 parts of water will kill any fish that may be present. In small doses, however, the poison has no effect upon mammals or frogs. An examination of the fruit has been made by M. A. Hébert, who, contrary to expectation, found it to be quite free from strychnine, and to contain only a trace of brucine, the amount in the kernels, which contained the most, not exceeding 0.05 per cent. A substance, probably a glucoside, was isolated, which was found to have the characteristic toxic action upon fish.

GEOLOGY.

By EDWARD A. MARTIN, F.G.S.

Women Geologists.

THE question of the admission of women to Fellowship of the Geological Society of London has been referred to the Fellows resident in the United Kingdom, who have been asked to vote thereon, and return their voting papers by May 1.

The Greywethers of Marlboro' Down.

The preservation of these interesting stones, to which reference was made in a former number, has been assured. The money required to make up the balance of the purchase-money for the ground on which they are situated, has been granted by the Royal Society, and thus the object of the National Trust has been achieved.

Professor Seeley's Field Class.

I am glad to again note the beginning of Professor H. G. Seeley's Geological Field Class, on May 9. Many of our readers have, no doubt, in years gone by taken advantage of this excellent means of studying geology in the field, and it is hoped that the class may long continue. For 22 years Professor Seeley has conducted the class. The students are taught in the open country and in quarries, and thus they learn direct from nature. The history and origin of the face of the earth, as seen in hill ranges, plateaux, valleys, river channels and cliffs are examined. Portions of layers of rock are followed through the country as they rise to the surface, so as to exemplify their order of succession, modes of occurrence, mineral structure, and the fossil life which each layer preserves. The country is examined as though it were studied for the first time. It thus becomes a laboratory for the student, used by him in the same ways as it was used by observers who gathered the knowledge which has become geology.

The subject for the season is the history of the Thames and its tributaries, and the excursions include the following: The Wealden Watershed (Frant); Breaching the Chalk Escarpment (Otford); The Chalk Bar on the Lower Thames (Purfleet); Valleys Carved by Land-Springs (Hampstead and Highgate); Sea Work and River Work. London Clay (Sheppey or Herne Bay); Union of the Isis and the Thames (Radley).

It will be seen that an attractive programme has been arranged.

"Walker Miles."

Although not a geologist himself, Mr. R. E. Taylor, better known as "Walker Miles," did much to render the country accessible to geologists, by his numerous publications on the field-paths of the Home Counties. I think, therefore, geologists as well as many other ramblers will join with me in an expression of regret at the news that he has just passed away. He did a good work and one that will live long after him.

An Oxford Clay Saurian.

Two skulls of *Metriorhynchus brachyrhynchus*, Deslong., have recently been obtained by Mr. A. N. Leeds, F.G.S., from the Saurian zone of the Lower Oxford Clay, in the neighbourhood of Dopthorpe, Peterborough. No other parts of the skeleton were found with them, even the mandibles being missing. This is the first recorded occurrence of the species in England; and as the specimens help to throw additional light on the cranial osteology of the species, especially in the parts which are wanting in the type-specimen, they are described in order to amplify Deslongchamps' description. The skulls are neither of them perfect, but one fortunately supplements the other, and both are perfect in one of the most interesting parts, the frontal region and the part from the nasals to the premaxillæ.

This species was first described by E. E. Deslongchamps in 1868, and was based on an imperfect skull, obtained from Calvados, Normandy. He was led to distinguish it from other species by the shortness of its snout. He mentions one other mutilated skull found near Poitiers, and there is a third in the Muséum de la Faculté des Sciences at Caen. The specimens now obtained have been described by Mr. E. T. Leeds, in a paper before the Geological Society of London.

Foreign Boulders in the Chalk.

In discussing this subject, one is frequently exercised to know how boulders of granite have come to be imbedded in the soft foraminiferal mud, which afterwards came to be consolidated into chalk. Of course, iceberg action has been invoked as an explanation, and it is a possible one. The *Challenger* brought up in the dredge, when in the North Atlantic, in the neighbourhood of the iceberg-swepped seas of Nova Scotia, an immense boulder, which may have been dropped by a mountain of ice. It was an interesting occurrence, although, unfortunately, the boulder had to be tipped overboard from whence it came. But it has been pointed out that these boulders may have been

carried into the chalk sea in the roots of an uprooted tree. When on a visit to North Wales, I took a photograph of such a tree, which had a number of stones imbedded in its roots. It will be seen from the illustration that one large boulder still remains amongst the roots, and it is quite conceivable that had this happened near the coast, such a tree might have floated some distance before it unshipped its burden.

METEOROLOGY.

By WILLIAM MARRIOTT, F.R.Met.Soc.

Rippling of Distant Lights.

MR. SPENCER C. RUSSELL, of Parkside, Ashley Road, Epsom, has forwarded the following observations on the scintillation of the electric lights at Worthing, as seen from Brighton, which he made between March 12th and 19th:—

Time.	Wind.	Force.	Weather.	Worthing Lights.
12th, 8 p.m.	N.E.	1	Fine, moonlight.	Steady.
,, 10 ,,	Calm	0	Sea fog.	Invisible.
13 h, 8 ,,	S.	2	Cloudy.	Scintillating and undulating rapidly.
,, 10 ,,	S.	1	Fine, moonlight.	Scintillating.
14th, 8 ,,	E.S.E.	2	Fine, misty.	Invisible.
15th, 8 ,,	Calm	0	Overcast.	Steady.
,, 10 ,,	,,	0	,,	,,
16th, 8 ,,	W.	1	Fine, moonlight.	Scintillating.
,, 10 ,,	W.	2	,, ,,	Scintillating and undulating rapidly.
17th, 8 ,,	N.N.W.	1	Fine, foggy.	Invisible.
18th, 8 ,,	N.	1	Fine.	Steady.
19th, 8 ,,	N.E.	2	,,	,,

Mr. Russell is of opinion that an off-shore breeze, or the absence of any breeze, is unfavourable to the phenomenon.

The Anticyclonic Belt of the Southern Hemisphere.

At the meeting of the Royal Meteorological Society on April 15th, Colonel H. E. Rawson, C.B., R.E., read a paper on "The Anticyclonic Belt of the Southern Hemisphere." He said that from an examination of the daily synoptic charts of the northern hemisphere he was led to the conclusion that some of the permanent anticyclonic systems had a progressive seasonal movement which did not take place along the same latitude each

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year, but was in some years north and in others south of a mean latitude. This was noticeable in the years 1881-1891, and was capable of easy explanation if the belt itself in which they moved shifted its latitude from year to year in addition to migrating north and south with the sun. On analysing the isobaric charts of the southern hemisphere be found that the seasonal migration of the anticyclonic belt is seen to be accompanied by a real displacement of the action-centres within it to the northward and to the southward. But when the charts are compared great discrepancies are found to exist in the positions of the centre if the years to which they refer are not the same. Also when they are prepared for a long period of years the action-centres show a much wider displacement from a mean latitude than for a short period. In one case charts which were published in 1879 were considerably modified in 1883, the area of maximum pressure within the belt being shown farther south. At the Cape a "monsoon" influence associated with the winter months of the years 1896-1900, in connection with the North-west wind is found to exist, which was not traceable in the years 1842-1855, 1862-1865. At Durban a decided increase in the percentage frequency of winds with a Westerly component in the winter months of the years 1892 and 1893 is traced to an increased prevalence of the same North-west wind, and it is found to prevail in an exceptional manner during the summer months also. This wind is proved to indicate the arrival at Durban of the south side of the anticyclonic belt, and the inference is drawn accordingly that during 1892 and 1893, when it prevailed throughout both summer and winter months, the south side of the belt was much farther north than usual. Colonel Rawson went minutely into these matters in his paper, and showed that the rainfall also varied according to the movement of the anticyclonic belt north or south of its mean position. It appears that there is a period of about 9·5 years between the greatest north and greatest south position of the anticyclonic belt over South Africa, the double oscillation thus taking 19 years.

Stonyhurst Observations.

The Rev. W. Sidgreaves, S.J., the Director of the Stonyhurst College Observatory, has issued his annual volume of "Results of Meteorological and Magnetical Observations" for 1907. This observatory is in lat. 53° 50′ 40″ N., long. 9 m. 52s·68 W., and the height of the barometer above sea level is 381 feet. The year was, on the whole, an average one for barometric pressure, temperature, rainfall, and wind force. There were no marked extremes of temperature; it was never above 70° nor below 20°. June was a most unsummerlike month, with the greatest rainfall, least sunshine, and lowest mean temperature in the June records of the Observatory. The following table gives the rainfall and hours of bright sunshine for each month in 1907, together with the differences from the average:—

Months.	Rainfall.		Sunshine.	
	1907. Ins.	Difference from Average 60 Years.	1907. Hours.	Difference from Average 27 Years. Hours.
January	3·00	− 1·14	35·5	+ 1·3
February	3·51	+ ·06	77·8	+ 17·9
March	5·64	+ 2·29	168·6	+ 59·1
April	1·80	− ·65	114·3	− 36·2
May	3·63	+ ·99	109·8	− 77·5
June	8·71	+ 5·25	109·0	− 83·9
July	3·30	− ·68	175·7	− 4·7
August	6·21	+ 1·13	125·3	− 26·5
September	1·16	− 3·21	118·1	− 10·0
October	3·86	− 1·23	78·4	− 8·4
November	3·34	− 1·04	50·7	+ 6·2
December	5·76	+ 1·27	17·5	− 8·2
Year	49·92	+ 3·04	1180·7	− 170·9

The mean magnetic declination for the year was 17° 41′·8 W., and the mean horizontal force 0·17404 C.G.S. units.

Weather and Vegetation.

Mr. Edward Mawley presented his "Report on the Phenological Observations for 1907" at the last meeting of the Royal Meteorological Society. He pointed out that the most noteworthy features of the weather as affecting vegetation were the cold and sunless character of April, May, and the three summer months; the frequent falls of rain during that period; the warm, dry, and sunny weather in September; and the heavy and continuous rainfall in October. Wild plants came into blossom behind their usual dates throughout the whole of the flowering season. Such early immigrants as the swallow, cuckoo, and nightingale were also behind their average dates in reaching these islands. The only deficient farm crop, taking the country as a whole, was that of potatoes, most of the other crops being much over average. On the other hand, the yield of apples and pears, and particularly that of the former, was below average. There was also a deficient crop of strawberries; whereas plums, raspberries, currants, and gooseberries were over average. As regards the farm crops, Mr. Mawley stated that 1905 was a plentiful year, in 1906 the yield was even better, while the past year proved the most bountiful of the three.

Falmouth Observations.

The Falmouth Observatory Report for 1907 by Mr. Wilson Lloyd Fox and Mr. Edward Kitto has been received. The mean temperature, 51°·5, was 0°·4 below the average of the last 25 years. The months of January, February, April, May, June, July, and August were also below, whilst those of March, September, November, and December were above, and October was the same as the average. June was exceptionally cool, the mean temperature being 56°·1.

As at Stonyhurst, the rainfall for the year was above and the hours of bright sunshine were below the average, but in different degrees, as will be seen from the following:—

Months.	Rainfall.		Sunshine.	
	1907. Ins.	Difference from Average 25 Years.	1907. Hours.	Difference rom Average 25 Years. Hours.
January	1·81	−2·54	74·5	+ 17·4
February	2·38	−1·11	75·7	− 7·1
March	1·43	−1·65	177·6	+ 39·9
April	5·78	+3·23	200·4	+ 20·2
May	3·11	+0·94	156·4	− 80·0
June	3·87	+1·77	120·7	−108·1
July	2·78	+ ·03	244·3	+ 18·2
August	1·87	−1·23	148·0	− 65·9
September	2·55	− ·61	152·1	− 8·1
October	7·29	+2·50	114·7	− 1·9
November	6·68	+1·89	62·3	− 11·5
December	5·28	− ·44	35·5	− 19·9
Year	44·83	+2·78	1562·2	−206·8

The mean magnetic declination for the year was 1 8° 0′·4 W. and the mean horizontal force 0·18799 C.G.S. units.

ORNITHOLOGY.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

An Ornithologist's Wanderings.

THOSE who have a love for the wider problems of ornithology should make a point of reading "Three Voyages of a Naturalist," by Mr. M. J. Nicoll (London: Witherby, 1908; 7s. 6d. net), a book which has just left the publisher, and which will be found crammed with the most interesting facts relating to bird life.

We are glad to know that the awful volcanic eruptions of St. Pierre and Martinique were after all not so completely destructive of bird life as was at first feared. These islands and their bird-fauna are well described by the author, who has also some new observations on the moulting-habits of the Cape Penguin, which appear to moult fasting, living only on an accumulated store of fat beneath the skin; a common device for evading the pangs of hunger during enforced abstinence. But we shall review this book in the pages of "KNOWLEDGE" shortly. Meanwhile, our advice to the readers of this column is "Get it!"

XUM

The Significance of the Coloration of Birds.

There are few writers on field natural history who can command so much respect as Mr. F. C. Selous; there are few indeed who have lived so long in the wild places of Nature, and have carried with them so keen a sense of discrimination of what is worth recording. We would, therefore, draw the attention of our readers to Mr. Selous's latest book, "African Nature Notes," for therein he has some pertinent remarks on the coloration of birds and of certain of the larger game-animals which demand attention, and which, we venture to think, will soon create something of a stir among those who have built much on "Protective Coloration" and similar foundations. Space forbids a more detailed statement in this column.

White-Winged Lark in Sussex.

In a note to *British Birds* for April, Mr. J. B. Nichols records the fact that on December 30, 1907, a male and, on January 1, 1908, a female White-winged Lark (*Melanocorypha sibirica*) were shot at Pevensey Sluice, Sussex. Only four previous occurrences of this species in England have been recorded.

Tengmalm's Owl in Shetland.

According to the *Field* (April 4), a Tengmalm's Owl (*Nyctala tengmalmi*), apparently a female, was taken in the Shetlands on January 4. This appears to be the fourth record of this species in Scotland, and the second for Shetland.

Nutcracker in Kent.

Always a rare visitant to the British Islands, the Nutcracker has apparently occurred but four times in Kent. A fifth record has now been added to the list by Mr. Norman Richardson, who, in the *Field* (April 4), records the fact that a specimen was shot "in Kent," on December 29 last. But he does not say whether this belonged to the typical form (*Nucefraga caryocatactes*), or to the Siberian race (*N. C. macrorhynchus*).

Rough-Legged Buzzard in Hants.

According to the *Zoologist* for April, a female Rough-Legged Buzzard was shot at Ringwood, Hants, on February 8. The weight thereof is given as 3 pounds, the expanse of wing as 48 inches, and the length as 23 inches, which appears to be some 3 inches shorter than the average length.

Honey Buzzard in North Wales.

The *Zoologist* for April also records the shooting of a Honey Buzzard, "a fine male," at Abergele, North Wales, on October 15, 1907. We cannot but regret the shooting in both cases.

PHYSICS.

By PROFESSOR A. W. PORTER, B.Sc.

The Heating Effects Produced by Röntgen Rays.

PROFESSOR H. A. BUMSTEAD, two years ago, came to the conclusion that Röntgen rays produced different amounts of heat when falling upon different metals; *e.g.*, approximately twice as much was produced in lead as in zinc. He now realises that this result was due to a source of error inherent in his apparatus, viz., the greater rate of loss of heat by the zinc for a given temperature excess over the surroundings than by the lead. In the original experiments, small strips of two metals (of different thickness, so as to produce equal absorption of the rays) were held by an ebonite support, so that each strip was opposite one vane of a radiometer made of thin aluminium foil, and suspended by a quartz fibre. Röntgen rays could be admitted through an aluminium window in a screen, and the deflections of the radiometer read by a telescope. The repulsion of one of the vanes was, of course, primarily dependent on the temperature of the surface of the strip to which it was exposed; to make the radiometer deflections a measure of the quantities of heat developed in the two metals, it was necessary that the rate at which the two metals lost heat per degree excess temperature should be the same. But apparently the conduction through the supports prevented this from being the case. This fresh conclusion will probably be accepted with satisfaction by all interested in the question, because the original conclusion was felt to be one which required considerable revision of our views of the atom.

The Solidification of Helium.

It turns out that the supposed solidification of helium by Professor Kamerlingh-Onnes was due to the unfortunate admixture of hydrogen with the gas experimented upon. We are therefore as far off as ever from producing a change of state in this refractory gas. We may take Olszewski's failure to liquefy it even at 1.7° absolute as the last experimental fact on the subject.

Of course, this estimate of 1.7° is not absolutely free from question, as such a low temperature could be estimated only from the sudden adiabatic expansion to which he subjected his gas. The only safe guide in connection with such an estimate is a knowledge of the critical data for the gas. To expand carbon dioxide near its critical point to twice the volume produces a different lowering of temperature than if the change of volume is made in a state remote from the critical one. Now, of course, until helium can be liquefied, nothing is known as to its critical temperature. Olszewski's estimate must, therefore, be considered as a rough approximation only; and yet as the best one that can be made at the present time.

There is no reason at all to modify my expectation that if helium is made to change its state at atmospheric pressure, this change will be solidification.

The Tempering of Steel.

A new method of gauging the correct temperature in the tempering of tool-steel has been devised by Messrs. Taylor and Mudford. The gauge consists of a permanent magnet, shaped conveniently for holding in the hand, its poles being prolonged by rods of a special metal which remains magnetic at temperatures higher than the hardening temperatures of carbon steels.

Its action is based on the discovery that every variety of carbon steel, when heated, becomes non-magnetic at the temperature at which it should be hardened. The steel to be hardened is placed on the legs, to which it clings until its magnetic quality disappears, when it falls into the vessel of brine placed to receive and cool it. The gauge here described is suitable for light tools, such as small taps, drills, turning-tools, etc., having a section not exceeding $\frac{3}{8}$-inch square. It is not intended for large work.

The Positive Column in Oxygen.

The Rev. P. J. Kirkby finds (*Phil. Mag.*, April, 1908), that when the electric discharge takes place in oxygen at various pressures, and the electric force in the positive column is measured, there is a discontinuity in the curve obtained by plotting the electric force against the pressure. The interesting point is that this occurs at practically the same pressure, viz.: 8 mm. of mercury, as that at which Bohr and also Baly observed a discontinuity when experimenting on the validity of Boyle's law at low pressures. The suggestion is made that the peculiarity is due to the formation of ozone; and that different degrees of dryness of the experimental tube may account for some observers (*e.g.*, Lord Rayleigh) having failed to detect any peculiarity.

ZOOLOGY.

By R. LYDEKKER.

The Food of Otters.

WITH the exception of the sea-otter of the North Pacific, which has long been known to feed on sea-urchins and other hard-skinned marine creatures, it has hitherto been supposed that otters fed almost exclusively on fish. It appears, however, from a paper by Dr. Einar Lönnberg that this is not the case with an African clawless race (*Lutra capensis hindei*), whose food consists mainly of crabs, supplemented by an occasional egg or young bird. This otter is, moreover, much less agile in the water than the European species, and its immediate relatives, being unable to remain so long beneath the surface, and when hunted seeking refuge on shore rather than in what has hitherto been considered its native element. In fact, there is every probability that it is unable to capture fish, except when they are penned up in small pools during the dry season. Correlated with this crab-eating habit is the blunter character of the crowns of the cheek-teeth, which lack the sharp cusps of our own otter. This crab-eating otter does not enter into competition with the fish-eating species, and it is, therefore, interesting to find that a representative of the latter inhabits the same rivers.

Extinct British Reptiles.

Two important contributions to our knowledge of British fossil reptiles are made in the March number of the *Annals and Magazine of Natural History*. In the first of these Baron F. Huene asserts that the tooth from the Warwickshire Rhætic on which the genus and species *Palæosaurus platyodon* was established belongs, not, as hitherto supposed, to a dinosaur, but to a belodont crocodile (Phytosauria). Moreover, as the name *Palæosaurus* is preoccupied, the reptile in question will in future have to be known as *Rileya platyodon*, the generic name *Rileya* having been applied to belodont bones from the same horizon. In the second communication Dr. A. Smith Woodward describes the tibia (lower leg-bone) of the well-known dinosaurian genus *Megalosaurus* from the Lias of Warwickshire. The record is of special interest, as hitherto the only evidence of that genus in the Lias has been a single tooth in the collection of the British Museum.

The Indian Elephant in Mesopotamia.

A paragraph recently appeared in a contemporary pointing out that the ancient Assyrian records afford practically conclusive evidence as to the former existence of elephants in the Euphrates valley. Confirmation of this is afforded by the discovery in Armenia during the Crimean War of fossil or sub-fossil remains of an elephant apparently intermediate between the living Indian species and the mammoth. Under the light of the new evidence there seems, however, little doubt that the Euphrates elephant was a western race of the Indian species, which was killed off during the early historic period. Mention of the mammoth reminds me that an American writer has recently given a restoration with the tips of the tusks curving downwards instead of upwards. It is suggested that the tusks were employed somewhat in the fashion of rakes for digging in the snow. Unfortunately for the theory, the skull of the Ilford mammoth in the British Museum shows that the upward curvature of the points of the tusks is correct.

One other point connected with elephants has much interested me. A gentleman recently brought to the British Museum about half-a-peck of stones asserted to have been taken from the stomach of an African elephant. The stones are quite angular and unworn. It was stated by the donor that other instances of the same nature are known to hunters. If such stones are habitually swallowed by elephants, one wonders, in the first place, that they do not seriously damage the molar teeth, and secondly, why it is that they do not become rounded. It may be added that the same gentleman recently demonstrated the existence of the stone-swallowing habit in crocodiles.

Bat-Migration.

Although we do not appear to have evidence of the occurrence of such a phenomenon in this country, it is now definitely ascertained that in North America certain kinds of bats make regular spring and autumn migrations like birds. Recently, for instance, numbers of bats were observed in Washington flying southwards in broad daylight at a great elevation.

Sir Richard Owen as an Observer.

I notice that at a recent meeting of the Zoological Society my friend the Secretary took occasion to remark that, although Sir Richard Owen had long since recorded that the nipples of the South American rodent known as the coypu are situated high up on the sides of the body, this fact is apparently unknown to the writers of modern textbooks. Evidently he thinks such writers tell all they know. In reference to the store of information in Sir R. Owen's work he might have added that not many years ago the occurrence of a gland near the root of the tail of dogs and foxes was brought to the notice of the Society as a new or little-known fact, and yet it was well described years previously by the great anatomist.

Papers Read.

At the meeting of the Zoological Society held on March 17 Dr. W. Kidd read a paper on the effects of pressure on the direction of hair in mammals, chiefly based on the observed effects of the pressure of harness on certain regions of the coats of domesticated horses. This pressure was shown to produce reversed areas of hair, and it was held that these results supported the view that changes in the arrangement of hair are due to mechanical causes. Fifty-three cases were cited, and eight different regions of the coats of the horse were shown in which the effects of pressure were found. At the same meeting Messrs. Thomas and Wroughton discussed a collection of mammals from Portuguese East Africa; while Mr. R. I. Pocock proposed certain changes in regard to the nomenclature of the Himalayan ruminants known as gorals and screws, and also named new races of the latter. At the meeting on April 7 Sir E. R. Lankester referred to certain peculiarities in the spine of the giraffe and the okapi, and Mr. K. Andersen monographed certain groups of flying-foxes.

The Apotheosis of the Parasite.

Cambridge has started a new journal—*Parasitology*—under the able editorship of Messrs. Nuttall and Shipley, to be devoted to all matters connected with parasites, such as mosquitoes, fleas, trypanosomes, infesting man and the higher animals. The remarkable development of the study of parasites during the last few years, especially in connection with the propagation of diseases, has in fact rendered such a publication a necessity. The first part, of which we have been favoured with a copy, is devoted to a paper by Dr. K. Jordan and the Hon. N. C. Rothschild, on fleas, and more especially the rat-infesting group (*Læmopsylla*), which appears to be the chief agent in the dissemination of plague. The memoir is profusely illustrated, and summarises practically the whole available information on the subject.

The Early Stages of the Alligator.

We have to acknowledge the receipt of a copy of a paper from Vol. LI. of *Smithsonian Miscellaneous Contributions*, on the development of the Mississippi alligator, in which Professor A. M. Reese traces the gradual evolution of the embryo from its earliest stages till the hatching of the young reptile. The paper is too technical for fuller notice in this column.

XUM

REVIEWS OF BOOKS.

ASTRONOMY.

Les Observatoires Astronomiques et les Astronomes par P. Stroobant, J. Delvosal, H. Philippot, E. Delporte, et E. Merlin (Bruxelles, 1907; 316 pp.).—M. Stroobant and some of his colleagues at the Royal Observatory of Brussels have found time to compile, from the most authentic sources they could think of, a directory of observatories, public and private; astronomers, professional and amateur, theoretical and practical; societies and journals; in fact, a complete guide to the personal element in astronomy. The word "complete" can, of course, only be used comparatively, for it would be too much to expect absolute completeness, and the authors themselves make no such claim, for they ask for additions and corrections. Armed with this volume an astronomer set down anywhere in the world should be able to find not only the names of any astronomers in the neighbourhood, but also the extent of their instrumental equipment and the particular branch of the science in which they are interested. Some of these details are manifestly lacking, especially in the case of the staffs of public observatories, but that is one of the directions in which improvement is hoped for in subsequent issues.

BOTANY.

Plant Biology, by F. Cavers, D.Sc. (Lond.) (London: W. B. Clive, 1907; price 3s. 6d.).—This is essentially a book for teachers, and to such it can be highly recommended. The author has embodied in terse language the results of much experience in teaching, and, as he states, "has tried to write the book in such a way as to render it of comparatively little use to the misguided type of student." This attempt has evidently been successful; if the observations and experiments are honestly followed out as clearly directed, a thorough grasp of the subject will result; to "cram" from the text alone is an impossibility. Physiology, ecology, morphology, and the general affinities of plants are dealt with in succession, and a proper sense of proportion is maintained. In this respect the book differs from many others, where morphology monopolises the greater portion of the instruction conveyed, the result being, the student at the end of his course may possibly be a good manipulator, but lacking in breadth of knowledge generally. We wonder whether the author has actually verified the time-honoured explanation as to the arrangement of the parts of the corolla in leguminous plants, for the purpose of effecting pollination through the agency of insects. The machinery undoubtedly works as described, but students of Mendelism, who have paid special attention to sweet peas, state that pollination is effected in the bud stage, long before the flower expands, and that the traditional account is not correct. There is also a glossary of terms, some of which might be improved upon. *Sinuate* is defined as having several large, blunt lobes on the smooth, wavy margin. The point in a sinuate leaf turns on the indentations between the lobes being rounded like a bay (*sinus*). The numerous illustrations are excellent and well-chosen.

MISCELLANEOUS.

Steam and Other Engines, by J. Duncan (London: Macmillan, 1907; 5s.).—This is a small volume intended specially for engineering students. We can recommend it as well to the less technical reader who wishes to get a familiarity with the details of engines of various types with which he nowadays must almost certainly come into contact. The descriptions of the various mechanical parts are especially clear, aided as they are by means of excellent diagrams. The principles of working are well put forward. Numerous examples are given.

Paradoxes of Nature and Science, by W. Hampson, M.A. (Cassell and Co.; 6s.).—In this volume we have an intelligent collection and discussion of various natural and experimental phenomena which are usually regarded as curious or paradoxical. It is not everyone who will answer off-hand the question:—When a train is going at sixty miles an hour, what part of it is moving backwards? He will find the answer to this question here along with numerous others. Boomerangs, The Way of a Bird in the Air; A Vessel Too Hot to Boil Water; Freezing Produced by Boiling; The Radium Clock which is never Wound and never Stops; Optical Illusions; these are a few of the numerous things discussed. In general, the explanation given is correct, and is, moreover, given in simple language. Occasionally, exception must be taken to some of the explanations. We do not think that the explanation of Tripler's reputed success in liquefying air, as given on page 177, is at all possible. The explanation of the well-known problem of Achilles and the Tortoise is an amazingly confusing attempt to explain what is in reality very simple. It occupies twenty-one pages; and the solution is made to depend upon non-continuity of space. We will merely point out that the algebraic equation which gives the correct time of Achilles overtaking the tortoise assumes continuity in the variables; and we will ask him to reconcile this fact with his attempted explanation. The true explanation is, of course, that Achilles does not overtake the tortoise at any instant included in the specification in the question; but the time so specified has only a limited duration, and is not the infinitely long time which the use of the term *never* erroneously leads one to expect. Apart from a few confusions of this kind we can, however, recommend the book as very instructive to the general reader.

We have received a copy of a work of 26 pages, entitled **Truth; Experimental Researches about the Descent of Man** (London: A. Owen and Co., 1908; 1s. net), in which the author, Mr. H. M. B. Moens, proposes to make certain remarkable experiments on living man-like apes. We have also to acknowledge the receipt of a paper on Mutation in Mosquitoes (*Weber's Archives*, No 2), by Mr. S. E. Weber, in which it is claimed that mosquitoes or gnats of more than one species have been bred from eggs of *Culex pipiens*.

BOOKS RECEIVED.

Logarithmic and Other Tables, by F. Castle (London: Macmillan, 1908; pp. 36; 6d. net).

Health at its Best, by R. Bell (London: Fisher Unwin, 1908; pp. 320; 5s. net).

Message to Mankind, by J. Lebolo-Carey (Port Talbot, South Wales: Published by the Author, 1908; pp. 73; 1s.).

An Introduction to Electricity, by B. Kolbe (London: Kegan, Paul and Co., 1908; pp. 416; 10s. 6d. net).

Lays of Hellas, by the late C. A. Kelly (London: Kegan, Paul and Co., 1908; pp. 161; 3s. 6d. net).

The North Sea, by W. H. Wheeler (London: J. D. Potter, 1908; pp. 41; 2s. 6d.).

THE "Herbert Smith" Refractometer, which can be used for determining the refractive index of crystals, is a well-known instrument. A new type of it has now been constructed, and Dr. Herbert Smith has written a booklet descriptive of the properties and uses of the new model, and embodying besides, references to the principles of its construction. The booklet, which is published by Messrs. J. H. Steward, 406 and 457, Strand, the manufacturers of the instruments, is intended to be a companion to the refractometer; and in it particular attention is paid by Dr. Herbert Smith to the usefulness of the instrument for the discrimination of faceted gem stones. A descriptive table, which summarises the principal physical characters of the gem stones, is of considerable value and is in some respects unique, giving, as it does, the nature of the refraction, the greatest and least indices of refraction, and the density and degree of hardness of each stone.

MR. C. BAKER, of 244, High Holborn, sends us his very useful quarterly classified list of second-hand instruments. It gives particulars of 1,217 pieces of apparatus, ranging from binocular microscopes to induction coils, telescopes to Zeiss refractometers, and bi-unial lanterns to cameras. The catalogue contains precise and very detailed descriptions of all the articles offered for sale.

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, B.A., F.R.M.S.

The Preparation of Microscopical Objects.

(*Continued from page* 90).

When objects have been stained in bulk they can be cleared also in bulk, say in cedar oil, after the hardening in chloroform, then cut and mounted direct, but the knife must now be flooded with cedar oil instead of alcohol. The final soaking, however, in 95 per cent. alcohol, which is the last stage of dehydration before clearing and mounting, must not be omitted, but in this case it will precede the hardening and clearing instead of following them. This applies particularly to objects which have been kept for some time in 70 per cent. alcohol. The sections and object must not be allowed to dry. Lee recommends a modification of this method, *i.e.*, that after the hardening in chloroform the mass should be put into a mixture of one part of chloroform to one or two parts of cedar oil, and that from time to time more cedar oil should be added so as to bring the mixture gradually up to pure cedar oil. As soon as the object is cleared throughout, the mass may be exposed to the air, and the rest of the chloroform will evaporate gradually. The object may now be mounted on the microtome holder with a drop of thick celloidin, and either cut at once, or kept indefinitely without change in a stoppered bottle. It may be cut dry, if done within a few hours, and the cutting quality is often improved by allowing it to evaporate in the air for some hours. It is better to begin the hardening, however, with pure chloroform, rather than with the chloroform and cedar oil mixture, whilst pure cedar oil is much slower than the latter. Lee strongly recommends these methods, as being much quicker than the older method, as giving a more transparent mass, and enabling the object to be cut dry.

Gilson's rapid process much shortens the preliminary stages of embedding. The object is dehydrated as usual, then saturated with ether instead of ether and chloroform, and put into a test-tube containing the thin celloidin solution. The lower end of the tube is dipped into a paraffin bath of melted paraffin and the celloidin allowed to boil at this low temperature (which does not harm the tissues) until it has been reduced to about a third of its volume, and is of the consistency of thick syrup. The mass is then turned out, mounted on a block in the ordinary way, or on a block of hardened celloidin, and the whole hardened for about an hour in chloroform or in a mixture of chloroform and cedar oil. If chloroform only has been used it is then cleared in cedar oil, which is not necessary if the mixture has been used. It is now cut in the usual way, using cedar oil to flood the knife. The warm bath shortens the process to an hour or so for small objects instead of some days, and the hardening is also proportionately reduced in time.

Scholz also recommends a rapid acetone method, in which the fresh tissue is fixed in formalin or alcohol, then put into acetone for 30 minutes to an hour in an oven at 37° C., then put into thin celloidin for four to five hours, then into thick celloidin for two to three hours, maintaining the same temperature throughout, hardened in chloroform for 12 hours or more, transferred to 70 per cent. alcohol for some hours, and then cut. The rest of the mounting process is as before.

Stepanow's method is to make a solution of 15 grm. of celloidin, 50 cc. of oil of cloves, 200 cc. of ether, and 10 cc. of absolute alcohol. Transfer the hardened specimen from strong alcohol to a small portion of the solution in a closed bottle; leave three to six hours; put into position on the mounting block and place in pure chloroform, alcohol, or benzole. The proper consistency for section cutting is secured in two to three hours, after which transfer to 80 per cent. alcohol. If the specimen, after sections are cut from it, is to be kept, remove it from the block and place it in chloroform.

(*To be continued.*)

Royal Microscopical Society.

March 18.—The Right Hon. Lord Avebury, P.C., F.R.S., President, in the chair. Mr. J. Ciceri Smith exhibited and described his micrometer caliper gauges with direct reading. They were of different sizes and patterns suitable for various purposes, but the one to which he particularly referred was a small pattern suitable for such purposes as measuring the thickness of cover-glasses. An important feature was the facility with which the thickness could be read off in figures to three places of decimals. Mr. C. F. Rousselet gave an account of a series of 14 mounted specimens of the rarer species of freshwater Polyzoa, which he exhibited under microscopes. They were mostly foreign species from Lake Tanganyika, Rhodesia, Northern India, America, and Japan. The President then delivered his annual address on the subject of "Seeds, with special reference to British plants," confining his attention on this occasion to those of the Dicotyledons and deferring the consideration of those of the Conifers and Monocotyledons to his address next year. He treated the subject from the point of view of the dispersal of the seeds and fruits by various agencies as follows:—Seeds or fruits with wings, which are carried by wind; seeds or fruits with feathery appendages carried by wind and sometimes by water. Seeds in capsules that open at the top, the seeds being jerked out by the wind. Seeds or fruits with hooks, which are carried by animals. Fruits which are eaten and the seeds thus carried by animals. Seeds which are thrown by the plants and those which are sown by the plants themselves.

Quekett Microscopical Club.

March 20.—Mr. A. E. Hilton read a paper "On the Cause of the Reversing Currents in Plasmodia of Mycetozoa." The general and microscopic appearances of a plasmodium were described, and also its usual habitats, structure, and physical condition. The surface plasm, hyaloplasm, is less mobile than the interior plasm in which alone occur the reversing currents. Each alternation of direction occupies about one-and-a-half minutes, with, of course, an excess in the direction of general movement. A number of general conclusions were given. The streaming movements in the finer threads of the network are controlled by the stronger currents in the coarser veins. The main currents radiate from and converge towards more or less definite centres of aggregation of plasm. If a fanlike extension is severed at its "isthmus of attachment" the impulse controlling the circulation is tem-

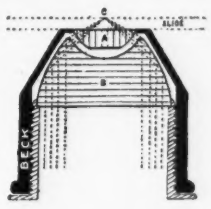
porarily lost, the streaming instantly diminishes and becomes disorganised. In such an excised portion recovery of circulation may come about by a denser portion of the mass becoming dominant and controlling from this fresh centre a new system of currents. It was suggested that the visible pulsations are indications of a respiratory function inherent in the whole mass of the plasmodium.

Mr. C. D. Soar, F.R.M.S., read a paper "On the genus *Hydrachna*." The name was first used by Müller in 1776, who applied it to the whole family of water-mites, and figured and described 49 species in 1781. Of the twenty-one British species now described, four were new to this country and three others were now first recorded in Britain. Drawings of all the twenty-one species and a chart showing the specific differences in the dorsal plates were exhibited.

Dark-Ground Illumination.

There are few microscopists in England who are not familiar with some at least of the various methods of dark-ground illumination which have been in use in this country for twenty or thirty years, and form part of the outfit of most English microscopes of the better class. The principle is, of course, a simple one, *i.e.*, to block out by means of a stop, or otherwise, the illuminating rays which pass through the centre of the condenser, and which correspond to the aperture of the objective, so that no light passes into the latter, and, in consequence, the field is quite dark. But the condenser having a wider aperture than that of the objective, the peripheral rays pass round the stop referred to and are caught and diffused by any object lying in the field of view, such object thus becoming in a sense self-luminous, and, therefore, seen brightly illuminated upon a black back-ground. It is to be noted that the stop behind the condenser must bear a definite relation to the objective used, cutting off all the rays which would normally enter such objective, whilst the condenser must have an excess of aperture over and above this to give the necessary annular illumination. In its simplest form the apparatus consists of a stop carried in a ring beneath an ordinary Abbe or achromatic condenser, the larger-sized stop being used with objectives of higher aperture, whilst more exact adjustment can be made by means of the Traviss expanding stop, described in these columns in July last ("KNOWLEDGE," 1907, p. 167). These simple stops have quite displaced the older forms of reflecting paraboloid and spot-lens, with their more exact adjustment, but correspondingly more perfect effect. Similar results are obtained by using an objective of higher aperture than that of the condenser, and by putting a stop of corresponding size to the latter behind the front lens of the objective.

At the present moment there seems to be a recrudescence of interest in the subject, as Zeiss, Leitz, and Reichert, with noticeable uniformity, have recently introduced paraboloid condensers for dark-ground illumination, more especially for higher powers, which differ only in detail from those above alluded to as long in use in this country. Zeiss' form is a paraboloid with a central stop and one reflecting surface, whilst Leitz's form has two reflecting surfaces, an internal and an external one, and both pass rays above 1.10 N.A. and cut out all those below. The objective used must, therefore, have an aperture of 1.0 N.A. or less, and a high-power dry lens can be used, or a high apertured immersion lens with a diaphragm above it (such as the Davis shutter) to cut down the aperture as required. The paraboloid form of condenser avoids colour fringes, so obvious in the cheaper spot form, but there are several drawbacks to its use with high-powers. An increasingly exact relation between its aperture and that of the objective is required, as above-mentioned; the source of light must be strong, a Nernst lamp or incandescent gas lamp with condenser being necessary; the centring of the condenser and objective must coincide; the condenser must, of course, be of high aperture, and



be in immersion contact with the under surface of the slide; and last, but not least, both slide and cover-glass must be of definite thicknesses. This last requirement is, of course, a considerable drawback to the use of the paraboloid for high-power work, and not a little credit attaches to Messrs. R. and J. Beck for the simple but ingenious way in which they have got over the difficulty. The accompanying sketch will make the arrangement clear. The upper lens A is in oil-immersion contact with the slide, whilst the paraboloid B is adjustable by means of a sleeve and rotating milled ring, so as to give the best results with all thicknesses of slips, the curved under side of A being concentric with the focus at C, and truncated to such an extent as to stop all light below 1.0 N.A. A $\frac{1}{12}$-inch immersion lens of 1.0 N.A. is very suitable for use with this paraboloid. This apparatus has many uses and, in particular, I know of no better way of showing living bacteria by what is generally known as the "hanging drop" method.

Microscopical Material.

By the kindness of Mr. J. H. A. Verinder, of Beckenham, I am this month able to offer to such of my readers as care to apply for it some peat from Loch Kinnord, which is exceptionally rich in freshwater diatoms. It is easily cleaned by any of the usual methods, and Mr. Verinder states that he has a list of some two hundred different species which have been found in this peat. This list was originally published in the Transactions of the Edinburgh Geological Society. Applications must be accompanied by a stamped, addressed envelope and by the coupon to be found in the advertisement columns of this issue of "KNOWLEDGE."

Notes and Queries.

New Catalogues.—Carl Zeiss has issued a collected list of apparatus dealing with ultra-microscopy and dark-ground illumination, containing full particulars of the necessary apparatus for the examination of living bacteria, cells, fibres, blood, colloidal solutions, etc., by means of a spot behind either the condenser or the objective. The catalogue also contains much explanatory matter. Messrs. W. Watson and Sons have issued a price list of microscopes for metallurgy, with lists of complete metallurgical outfits.

[Communications and inquiries on Microscopical matters should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge. Correspondents are requested not to send specimens to be named.]

The Face of the Sky for May.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 4.34 and sets at 7.20; on the 31st he rises at 3.52 and sets at 8.4.

Sunspots and faculæ may usually be seen on the solar disc; prominences, too, may be expected to be fairly conspicuous on spectroscopic examination of the limb.

The positions of the Sun's axis, equator, and heliographic longitude of the centre of disc are shown in the following table:—

Date.	Axis inclined from N. point.	Centre of Disc S. of Sun's Equator.	Heliographic Longitude of Centre of Disc.
May 5 ..	23° 28′W	3° 37′	152° 34′
,, 10 ..	22° 20′W	3° 4′	86° 28′
,, 15 ..	21° 2′W	2° 30′	20° 20′
,, 20 ..	19° 34′W	1° 55′	314° 11′
,, 25 ..	17° 57′W	1° 20′	248° 2′
,, 30 ..	16° 11′W	0° 44′	181° 52′

THE MOON:—

Date.	Phases.	H. M.
May 8..	☽ First Quarter	11 23 a.m.
,, 16..	○ Full Moon	4 32 a.m.
,, 23..	☾ Last Quarter	0 17 a.m.
,, 30..	● New Moon	3 15 a.m.
May 8..	Apogee	5 54 a.m.
,, 20..	Perigee	1 24 p.m.

OCCULTATION:—The following occultations of the brighter stars are visible at Greenwich.

Date.	Star's Name.	Magnitude.	Disappearance. Mean Time.	Disappearance. Angle from N. point.	Disappearance. Angle from Vertex.	Reappearance. Mean Time.	Reappearance. Angle from N. point.	Reappearance. Angle from Vertex.	Moon's Age.
			p. m.			p. m.			d. h.
May 4	μ Geminorum	3·2	8·48	95°	52°	9·46	272°	232°	4 5
,, 6	μ^2 Cancri ..	5·4	8·33	97°	57°	9·40	292°	249°	6 5
,, 16	ψ Ophiuchi..	4·6	11·15	137°	151°	12·22	265°	269°	16 8

THE PLANETS.—Mercury (May 1, R.A. 2^h 6^m; Dec. N. 11° 41′; May 31, R.A. 6^h 8^m; Dec. N. 25° 34′) is in superior conjunction with the Sun on the 7th, and hence during the former part of the month the planet is unobservable; towards the end of the month the planet is an evening star in Gemini setting at 10·4 p.m. on the 30th, or two hours after the Sun.

Venus (May 1, R.A. 5^h 43^m; Dec. N. 26° 55′. May 31, R.A. 7^h 21^m; Dec. N. 24° 50′) is an evening star in Gemini, setting about 11.30 p.m. near the middle of the month or nearly four hours after the Sun. The planet attained the greatest easterly elongation on the 26th of last month, hence she is at greatest brilliancy on the 29th of the present month, when she easily outrivals all the other planets and stars in splendour.

In the telescope the planet appears like the crescent Moon, only with more rounded horns; about the middle of the month 0·4 of the disc is illuminated.

The planet is so bright that she may readily be discerned in the S.W. portion of the sky immediately after sunset, before it is dark. This is the best time for observing, since later on account of the brilliancy of the planet any outstanding colour arising from want of achromatism in the object glass or eye-piece becomes more apparent and is detrimental to good seeing.

The Moon appears near the planet on the evening of the 4th.

Mars (May 1, R.A. 5^h 0^m; Dec. N. 23° 42′. May 31, R.A. 6^h 25^m; Dec. N. 24° 24′) is an evening star in Taurus, practically out of range for useful observation, as he sets soon after 10 p.m., and on account of increased distance from the earth shines with feeble luminosity. The Moon appears near the planet on the evening of the 3rd.

Jupiter (May 1, R.A. 8^h 31^m; Dec. N. 19° 45′. May 31, R.A. 8^h 46^m; Dec. N. 18° 46′) is a conspicuous object in the evening sky, although he suffers by comparison with Venus which lies a few degrees to the west. The planet is situated in Cancer and sets about 1 a.m, near the middle of the month.

The apparent diameter of the planet continues to diminish as the distance from the earth increases; the equatorial diameter on the 15th being 35″·1, and the polar diameter 2″·3 smaller.

The following table gives the satellite phenomena observable in this country:—

Date.	Satellite.	Phenomenon.	P.M.'s H. M.	Date.	Satellite.	Phenomenon.	P.M.'s H. M.	Date.	Satellite.	Phenomenon.	P.M.'s. H. M.
May				May				May			
1	III.	Tr. I.	8 46	7	IV.	Ec. D.	11 56	19	I.	Tr. I.	9 36
3	II.	Tr. I.	8 34	10	II.	Tr. I.	11 15		III.	Oc. R.	10 38
	II.	Sh. I.	11 11	11	I.	Oc. D.	10 24		I.	Sh. I.	10 48
	I.	Tr. I.	11 14	12	I.	Sh. I.	8 54	20	I.	Ec. R.	10 22
	II.	Tr. E.	11 30		I.	Tr. E.	9 59	24	IV.	Ec. R	10 46
4	I.	Oc. D.	8 27		I.	Sh. E.	11 14	26	III.	Oc. D.	11 9
5	II.	Ec. R.	8 46		II.	Ec. R.	11 21	28	I.	Sh. E.	9 32
	I.	Sh. E.	9 19		III.	Ec. R.	11 26	30	III.	Sh. E.	9 35

"Oc. D." denotes the disappearance of the Satellite behind the disc, and "Oc. R." its reappearance; "Tr. I." the ingress of a transit across the disc, and "Tr. E." its egress; "Sh. I." the ingress of a transit of the shadow across the disc, and "Sh. E." its egress; "Ec. D." denotes disappearance of Satellite by Eclipse, and "Ec. R." its reappearance.

Saturn (May 1, R.A. 0^h 22^m; Dec. N. 0° 4′; May 31, R.A. 0^h 33^m; Dec. N. 1° 7′) is a morning star in Pisces rising about 3 a.m. near the middle of the month.

Uranus (May 16, R.A. 19^h 12^m; Dec. S. 22° 49′) rises about 11.30 p.m. near the middle of the month. The planet is not well placed for observation, as he is situated low down in Sagittarius.

Neptune (May 16, R.A. 6^h 56^m; Dec. N. 22° 3′) is observable in the North-West portion of the evening sky, about 36′ North of the Star ζ Geminorum; on the 15th he sets about 11.30 p.m.

The planet is difficult to identify among the numerous small stars appearing in the same field of view, as it requires a high power (about 300) and good definition to distinguish his disc; he can, however, be detected by his relative motion if observation be made on successive nights.

METEOR SHOWERS:—

The principal shower during May is the *Aquarids*. This may be looked for between May 1 to 6; the radiant being in R.A. 22^h 32m Dec. S. 2°, near the star η Aquarii.

TELESCOPIC OBJECTS:—

DOUBLE STARS.—α Libræ, XIV.^{h} 46^m, S. 15° 39′, mags. 3, 6; separation 230″; very wide pair.

σ Coronæ, XVI.^{h} 11m, N. 34° 8′, mags. 6, 6½; separation 4″·8; binary.

α Herculis, XVII.^{h} 10^m, N. 14° 30′, mags. 2½, 6; separation 5″·0. Very pretty double, with good contrast of colours, the brighter component being orange, the other blue.

δ Herculis, XVII.^{h} 11^m, N. 24° 57′. mags. 3, 8; separation 14″.

CLUSTERS.—M13 (cluster in Hercules) is situated about one-third the distance from η to ζ Herculis, and is just visible to the naked eye. It is a globular cluster, and with a 3 or 4 inch telescope the outlying parts of the cluster can be resolved into a conglomeration of stars.